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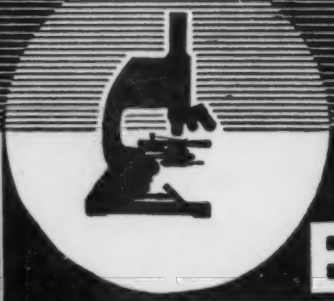

SCIENCE EDUCATION

THE SCIENCE MAGAZINE FOR ALL SCIENCE TEACHERS
FORMERLY GENERAL SCIENCE QUARTERLY

The Use of a Correlating Subject in Science Teaching

Science Teaching in Oklahoma High Schools

Two Methods of Teaching Agricultural Chemistry at the High School Level

Integrating 7th and 8th Grade Science and Mathematics

N. A. R. S. T. Meetings

State-Wide Testing Programs

Field Trips in the Elementary School

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A Food Unit

Activities for Nature Clubs

Obituaries

Orra Ervin Underhill
Ralph E. Horton

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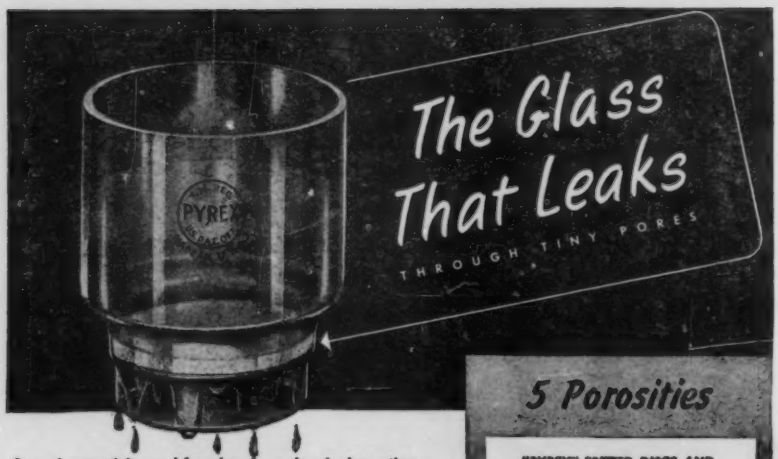

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Science Education

Formerly GENERAL SCIENCE QUARTERLY

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Volume 27 **DECEMBER, 1943** **Number 4**

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Science Education

THE USE OF A CORRELATING SUBJECT IN SCIENCE TEACHING

STANLEY P. REIMANN, M.D., Sc.D.
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There is an increasing tendency in practically all human endeavors to separate knowledge into compartments and carefully pigeon-hole it with smaller and smaller partitions. The obvious reason is, of course, increasing specialization which is at once the saving grace and the plague of knowledge. No longer is it possible for anyone to encompass the natural sciences in their detail. In fact there is no longer any branch of natural science in which any one individual can claim expertness in all of its subdivisions, minor or major. We have petroleum chemists, rubber chemists, steel chemists. There are mathematicians who are expert in statistics, others in vector analysis. There are physicians who are immunologists, allergists, laryngologists. The advantages are obvious; we become expert in a particular narrow field to serve some particular human purpose; it is through this expertness that we obtain the greatest efficiency and dispatch. No one denies that this is necessary. On the other hand, the need for specialization diminishes the possibility of and, in many cases, precludes general surveys which are so important in consolidating knowledge, in seeing relations, and in bringing to light new problems for solution.

Probably the majority of pupils in high schools are not scholars nor are they particularly interested in the solution of problems. When they are given expositions of narrow fields they tend to chafe, to remember details only to pass examinations and, what is more important, they fail to see how such studies can be of practical use in their every-day lives. If mathematics is taught as an isolated subject, if chemistry is put into a separate pigeon-hole and if, above all, biology, the science of living things, is treated just to dissect a grasshopper or to look at a piece of plant under the microscope, there is lacking a great spiritual stimulus to the application of this knowledge and to the guidance of a way of life.

There are those who say proudly, "This is the Age of Science." There are those who say "Yes, confound it, this is the Age of Science and see what it has done—built bigger and better guns and torpedoes and tanks and bombers and all sorts of engines of destruction; it has built communication systems to help propaganda and not truth."

But is this science? For just a moment let us examine what science demands. It demands first of all honesty; honesty in the observation and collection of facts for the scientific method and dishonesty are incompatible. It demands most meticulous care in the sifting of the wheat from the chaff; it demands the very highest integrity in the presentation of its data which means in its teaching. It demands that we suspend judgment until we know the facts and enough of them. It demands that we think things through and not indulge in wishful thinking. It demands that we test and test and test again and that we stop in between and think clearly and—objectively. Emotions, prejudices, preconceived notions go overboard. It demands too that we acknowledge mistakes promptly and unashamedly and—that we profit by them.

How many people use scientific principles in their daily lives?

Teaching honesty, integrity, objectivity, the value and technic of experimentation—in short, the methods of science—it is useful for pedagogical reasons to take a subject, the roots of which spread into all the different sciences, and show how at least the principles and such of the facts as are conveniently remembered can be used as a text. The subject remains to be chosen.

My pet subject is tumors, including cancer. No one can deny that it is of intense practical interest to every family in the land. Knowing of my interests you will perhaps, therefore, pardon me for choosing tumors as an example. I do it with realization of the limitations of time available for science in high school teaching and of the fact that most of the disciplines which I will mention as contributing to cancer knowledge are truly basic and therefore the main efforts must be directed to principles and phenomena. By this technic facts newly acquired in one field may be projected more readily and understandably into others.

Much more could be said in relation to the above generalities. In fact whole libraries and hours of discourse are spent on them but let us come immediately to specific cases.

The first consideration is the famous "cause of cancer." Not a week passes that I do not receive at least one letter informing me that the long sought "cause" has been found. It resides in everything from articles of food such as too much canned goods, to cooking in certain kinds of pots, to wearing woolen clothes or cotton clothes, to too little or even too much prayer, to too much nervousness, to too little nervousness, to too tight shoes, to shaving too often, to taking too many or too few baths, to using over-upholstered chairs, to sleeping with the bed headed in the wrong direction so that sonic vibrations pass through the body longitudinally instead of horizontally while asleep. It would seem, therefore, that cancer is an ideal subject for drilling into pupils the principles of cause and effect and interrelations. What better subject is there for insisting on the accumulation of data, the withholding of judgment and its final proper use, clear-sighted thinking, and honest experimentation.

Actually, of course, there are numerous "causes" of cancer such as allowing certain types of warts and moles to flourish and neglecting chronic irritation. It need not be pointed out here, but it is good for the population at large to know, that while these and other "causes" of cancer lead to the development of that atypical cellular growth which is cancer, we have not the faintest notion of why, let us say, a hot, short clay pipe stem resting on the corner of the lip of one individual will be followed by cancer and not in another individual. Nor do we know why this pipe stem produces in some individuals that peculiar kind of growth called cancer and not some other kind of growth, for instance, that which the tubercle bacillus produces.

Here is a clear example of how cancer can be used as a correlating subject to distinguish between Aristotle's famous four "causes," the "Efficient," the "Material," the "Formal" and the "Final." A thorough grounding in these, with cancer as a text, should be invaluable in later clear thinking. Naturally, we recognize today in science only the "Efficient" and the "Material" causes. We have no particular interest in "Formal" causes, and of the "Final" cause, not one word has science to say.

Tumors in general and cancer in particular are composed of cells which grow. Since all knowledge is comparative, there is but one comparison possible with cancer, and that is normal growth and development. Whenever we speak of living things we are in the realm of biology. The subjects of the greatest importance in biology as related to cancer are genetics and experimental embryology.

One of the early Greek philosophers announced his intention of writing a poem.

He said, as quoted from Needham, "I will neglect gold and will praise what is more precious than any metal. . . . If you would know of what it is that I intend to speak, it is the egg. Men marvel at the sun, at meteors flung from Heaven and stars swimming therein but this is the greatest of all wonders." Centuries later William Harvey's book, in which the preceding remark is found, had as its heading—"the efficient cause of the chicken is hard to be found out." It certainly is, but the efficient cause of the chicken must be our goal.

From the descriptive point of view an adequate exposition can be given of the embryological growth of many organisms, including man. The physiological aspect has also been added, especially in relation to the organizer phenomenon, fields, polarity, and other factors which influence cells in development. When these various items are considered, cancer intrudes. The tissues of cancer follow no definite morphological patterns. They do not respond to the organizing influences of the body as a whole, their abilities to differentiate and turn into various kinds of cells are distinctly abnormal and, of course, they do not organize at all into definite structural entities and parts.

Genetics, the study of inheritance, has the widest kind of application in human problems, not only in connection with the breeding of animals and plants, but of human beings themselves. In spite of the environmentalists telling us that given the right surroundings any human being can be made into a good and useful individual, there are such things as "bad eggs." Can anything be more important than for people at large to know of the laws of inheritance and how they inevitably grind out their products? There is need to teach the fundamental facts of inheritance. What precautions can be taken to defeat the operation of any inherited predisposition to cancer?

Overgrowths like tumors and cancers occur in plants. It is surprising how well they can be used as bases of illustrating, by contrast, normal growth in plants.

Need I say more about the ramifications of cancer in biology? It is apparent at every point. Transplantation, explantation, wound healing, repair and replacement, the effects of myriad environmental factors—food, warmth, chemical compounds, light, bacteria, viruses—all have applications to cancer.

MATHEMATICS

Mathematics has been used in cancer for many years in the form of statistics. So and so many cancer cases of this or that kind arise every year. Thus and so many die of cancer. This is all obvious but what is not so obvious is the relation of the teaching of mathematics to the implanting in young minds of the general idea that all of our knowledge is but a statistical approximation, that there are probably errors not only in our thinking but in the collection of our data; that opinions so freely expressed on every subject under the sun in quantitative terms without mathematical backing are merely non-logical statements or downright nonsense

CHEMISTRY

There is a chemistry of cancer itself, there is a chemistry of the body fluids in the victims, there is an environmental, so to speak, chemistry of cancer and there is an intra-cellular chemistry. All of this and more is a handsome correlating subject for general chemistry.

Comparisons must be made with inorganic chemistry, with organic chemistry, with normal physiological chemistry. Not the least advantage of such comparisons is the building up of a concept in young minds of the composition of matter as being dynamic. Change goes on about us constantly. We sometimes teach and if not explicitly, then implicitly, that the composition of chemical compounds is fixed. How long are they so? Are there not

equilibria even in inorganic mixtures of the most lifeless kind, using the word "lifeless" in the common sense meaning?

The chemistry of growth and development is the proper comparison with the chemistries of cancer. It is an opportunity to bring in nutrition, vitamins, hormones, salts, the knowledge of which has been so increased in the last twenty years or more. It should be fascinating to young minds to know how atoms can be "tagged" with a cyclotron and how they can be followed in their journeys through living organisms, especially through the human organism.

PHYSICS

Energy exchange is the omniscient motive power. Some time ago a parent asked a doctor to speak to his daughter who was dieting because she was afraid of growing too fat. The young lady in question, a sophomore in a neighboring college, was five feet, nine inches in height and weighed ninety-two pounds. She could work but two or three hours a day, she was tired and listless, did not enjoy the movies or dancing as a normal young woman should, had an anemia and was thoroughly discouraged with the situation of the world. Her diet consisted of a glass of orange juice for breakfast, several lettuce leaves for lunch and a salad for dinner. This was fortified with five or six cups of coffee per day and numerous cigarettes to take away the edge from her appetite. She was sullen and while her father, who was with her, recited her diet she resented every word he said. After a while the doctor turned on her and said, "Who do you think you are, God Almighty?" She answered in the negative. He then asked why she thought she could put aside the second law of thermodynamics. She said she did not even know what this meant. She was told it meant that energy cannot be created nor destroyed and all energy tended to be degraded. No human being can circumvent this law and therefore if she believed she could, as so amply evidenced by her behavior and her resulting appearance, she must at least be a genius of the first order. She saw the point but it took almost a year for her to recover. One is tempted to ask how in the world can anyone go through high school and two years of an excellent college without having learned such great truths as "matter cannot be created nor destroyed," "energy cannot be created nor destroyed," "all energy tends to be degraded." If in charity we dismiss this student as an exception, all we need do is analyze in scientific terms the public utterances with which we are assailed and chalk up the verbal and sometimes actual attempts to make a "perpetual motion machine!"

Just how the growing organism uses energy, where it obtains it, are subjects for teaching. Can physics be correlated with cancer? It can indeed and be made to tie in through this subject with chemistry, mathematics and biology.

PSYCHOLOGY

The abnormal in psychology, as well as in other subjects, is often an excellent guidepost to the normal. We find in cancer that people with various lumps and bumps and ulcers say to themselves this cannot be cancer, it might be in the other fellow but not in me. Lots of early graves have been filled by this philosophy. Numerous people are afraid that they have cancer and yet will not go to a competent physician to find out whether or not they have. They suffer untold mental anguish for months the agonies of uncertainty. This is a psychological point of much interest. "Shall the cancer patient be told" is another text covering a huge field in psychology. The fear complex, the spirit of bravado, the crusading impulse, the intuition, the savior of humanity desire, return of the spirit of the one dead, enter heavily into cancer. What a wealth of texts for psychological study!

SOCIOLOGY

Sociology is a popular "science" at present, or at least it is called a science, and on that there can be much debate. At any rate, the behavior of peoples, the control of emotions, thoughts, the guiding of actions by propaganda are parts of a tremendously important study. If someone from Mars, who knew nothing of any of our knowledge, were told of what we know about living things, how they grow and develop normally and abnormally, how they adapt themselves—if he were told what we know of chemistry, physics and other sciences and then were told about sociology, it is an extremely safe bet that he would immediately say that the first things that a sociologist should learn by heart so that they become part of his every fiber, are biology and chemistry and physics and genetics. I wonder how many of our sociologists are trained in these disciplines. Certainly many of them act as though they were ignorant of their very existence. Sociological problems loom large in cancer work. Many times the victims are cut off in the most productive years of their lives and leave motherless or fatherless homes.

Cancer is a chronic disease and between active treatments many patients do not need hospitalization. It is a first-class problem in sociology to meet the non-medical-technical needs in many cases, especially when some, as they do unfortunately, develop hopeless recurrences and slowly die. Nutrition has now been adopted as a fashionable subject by many sociologists, not only the procuring and distribution of food, but even its digestive and chemical sides although some of them seem to know about the latter only what they learn from newspaper and magazine advertisements. While food *per se* has never been shown to have any influence on the origin of cancer, nevertheless, it is of the utmost importance to cancer patients. Further needs in cancer for social work are in following patients and recording facts of progress.

As a summary of this presentation: Since there are the temptation and the actual practice of separating knowledge into compartments, and since schools must necessarily do this by reason of their curriculum needs (the students go from class to class and from subject to subject at the sound of a bell) it is, therefore, important that they be taught constantly the methods of correlation. To make students see the connections and interrelations between biology, chemistry, mathematics, physics, psychology and sociology, and then show how scientific thought directly affects the student himself in his everyday life would be a triumph. A few words on the Philosophy of Science might change a Chemistry Laboratory from a mass of terrifying formulae into a living, vibrant force directing a way of life into scientific principles of honesty, integrity, industry, cautious judgment and reasoned behavior.

SCIENCE TEACHING IN THE HIGH SCHOOLS OF OKLAHOMA

CLARENCE M. PRUITT
Oklahoma Agricultural and Mechanical College

This paper summarizes the results of four studies whose major purpose was to determine the status of science teaching in the high schools of Oklahoma in 1940[1, 2, 3, 4]. Information was obtained in the first three investigations by examination of reports on file at the State Department of Education.

A small high school was arbitrarily defined as a school having five teachers or fewer; a large high school as one having more than five teachers. Under these classifications data were obtained from 424 small public high schools, 347 large public high schools, and 25 Catholic high schools, a total of 796 Oklahoma high schools. The 424 small high schools had 424 science teachers, the 347 large high schools had 534 science teachers, and the 25 Catholic high schools had 28 science teachers, a total of 986 science teachers.

The total high school enrollment for the public high schools was not available, but the 25 Catholic high schools had an enrollment of 1,674, of which 600 (35 per cent) were enrolled in sciences. In the small high schools there were 348 men and 60 women teaching science; in the large high schools 395 men and 103 women; and in the Catholic high schools 5 men and 23 women. This is a total of 748 men and 187 women.

Thus it will be seen that while the median years of teaching experience was slightly less in the small high schools, there was not a significant difference. The above table indicates that small high schools have a greater percentage of science teachers who have had from zero to three years teaching experience, but difference is not as great as might have been expected.

TABLE I

TEACHING EXPERIENCE IN PUBLIC HIGH SCHOOLS

		Small	Large
0 years	Men	8.62%	6.07%
	Women	9.84%	6.62%
1–3 years	Men	22.70%	15.44%
	Women	36.07%	23.30%
Median years	Men	6.71	7.05
	Women	4.94	5.49
Average years		6.53	6.73

TABLE II

TEACHING EXPERIENCE IN PRESENT SCHOOL DISTRICT

		Small	Large
0 years	Men	35.50%	20.69%
	Women	36.07%	22.54%
1 year	Men	21.84%	16.85%
	Women	19.60%	21.56%
Median years experience		1.68	1.74

This table indicates that science teachers are a very mobile group both in small and in large high schools. Science teachers are constantly shifting from one school to another. The amount of shifting seems to be much greater in the large schools than might normally be expected.

Data are not presented here, but both studies show that there is no relation between the size of the school and the years of teaching experience. At first thought this may seem strange, but it is probably what should be expected.

In small high schools, 11 science teachers had no college degree, and 48 had a master's degree; 46 had no biology, 121 had no physiology, 73 had no physical science, and

[1] Payne, James W. "The Status of Science Teachers in the Small Secondary Schools of Oklahoma."

[2] Smith, Argus F. "The Status of Science Teachers in the Large Secondary Schools of Oklahoma."

[3] Franz, Sister Mary Lawrence. "The Status of Science Teachers in the Catholic High Schools in Oklahoma."

[4] Self, Olen M. "In-Service Training of Science Teachers in Oklahoma."

TABLE III

AVERAGE SEMESTER HOURS OF SCIENCE IN COLLEGE

		Small	Large
Biology		15.83	16.00
Physiology		6.22	4.25
Geography		5.40	5.50
Physical Science		8.46	18.11
Median hours	Men	33.04	36.44
	Women	30.67	34.00
Average		32.72	36.00

349 had no geography. In physical science, 343 teachers in small high schools had a total of 2,297 semester hours in chemistry and only 377 semester hours in physics.

In the large high schools the physical science median of 18.11 semester hours was divided as follows: Chemistry 9.45, physics 7.67, and geology 5.84. In the large high schools 98 (of 534 science teachers) had no college biology, 436 no physiology, 84 no physical science, and 410 no geography.

TABLE IV

COLLEGE TRAINING AND MONTHLY SALARIES

	Small	Large
123 hours	$93.50	$84.00
124–153	$104.53	$125.57
154 and over	$122.24	$148.46
Median salaries	$107.05	$122.61

In small high schools 14 per cent received a monthly salary of over $160, the highest reported being $189. This is accounted for by the fact that many men science teachers have administrative duties as principals or superintendents, in addition to their science teaching. The highest monthly salary reported by a science teacher in a large high school was over $260. In general, one can definitely state that the larger the school, the higher the salary paid.

TABLE V

EXPERIENCE AND MONTHLY SALARIES

	Small	Large
0 years	$82.12	$88.13
1–3 years	$92.60	$93.12
4–6 years	$111.06	$130.82
Median salary	$111.47	$128.11

In general one may say that more experience results in better salaries in both the small and the large high schools.

TEACHING COMBINATIONS

Mathematics is the most usual teaching combination with science in both small and large high schools. For men in small high schools history is the second most usual combination with science, and administrative duties (principal or superintendent) is third. For women, home economics is the first most usual combination with science and history second. For women, in the large high schools, mathematics is the most usual combination with science. In large high schools 39 teachers teach science only and 48 principals or superintendents teach science only. As many as 16 different subjects are taught by science teachers, practically every combination possible to find in the high school curriculum.

It is difficult to obtain absolutely accurate information relative to teaching load. These studies seem to indicate that science teachers have a somewhat heavier teaching load than do other high school teachers. Undoubtedly the load is considerably greater than it should be for the most efficient teaching. The average science teacher should spend much more time in laboratory and demonstration preparation than is usually done.

CATHOLIC HIGH SCHOOLS

The 25 Oklahoma Catholic high schools have 28 science teachers. The total enrollment is 1,674, with 600 or 35 per cent taking science. The percentage taking the various sciences is as follows: Chemistry 30 per cent, physics 23 per cent, general science 23 per cent, geography 15 per cent, and biology 8 per cent. These data are unusual in several respects. The total of 35 per cent taking science is considerably above the state per cent. Especially are the chemistry and physics percentages significant. The national percentages are about 7 per cent for chemistry and 6 per cent for

physics. General science is also above the national percentage, but for some reason biology is below the national average.

The science teaching situation in Catholic high schools is quite favorable and the amount spent for equipment for the most part is commendable. Catholic high school science teachers seem to be better prepared in chemistry and physics than are public high school teachers in these fields. Mean semester hours college preparation in various science fields are as follows: Chemistry (27 teachers) 17.40 hours; physics (21 teachers) 13.52 hours, biology (21 teachers) 13.62 hours, and geography (3 teachers) 13.0 hours. The median number of semester hours for the 28 teachers is 33.16 semester hours compared with 32.72 semester hours for science teachers in small public high schools. As in public high schools, mathematics is the most usually taught subject in combination with science.

These data seem to indicate that the percentage of pupils taking science in Catholic high schools is considerably greater than in public high schools, that the teaching load is probably more favorable in the Catholic high schools, that the equipment is probably some better, and that, on the average, in training in science there is practically no difference between the two groups. However, Catholic high schools science teachers seem to be better prepared to teach chemistry and physics than do public high school teachers.

IN-SERVICE TRAINING OF SCIENCE TEACHERS

In the spring of 1941 Olen M. Salf sent a questionnaire to a representative list of 418 Oklahoma science teachers to determine the in-service professional training of science teachers. Replies were received from 216 or 51.7 per cent. Of these returns 90 were from schools having an enrollment of over 150 pupils. A resumé of this study follows:

Science teachers indicated a self-realization of a greater deficiency of knowledge in the physical sciences than in biological science—26.8 per cent in chemistry, 25.1 per cent in physics, 24.5 per cent in biology, 11.6 per cent in astronomy, and 10.6 per cent in geology. Of the 216 teachers reporting, 155 had a Bachelor's degree, and 52 had a Master's degree, and 2 a Doctor's degree.

As in the three previous studies, mathematics was the teaching subject most usually found combined with science (49.1 per cent), history was second, and home economics was third.

In-service training agencies used include: attending summer school, 76.4 per cent; attending Saturday classes, 17.1 per cent; extension courses, 15.3 per cent; correspondence courses, 13.0 per cent; and visiting other teachers, 41.7 per cent. This latter per cent is actually quite low as only 90 teachers out of 216 would admit they had ever visited the classroom of another teacher (9 teachers had made 1 visit, 21 had made 2 visits, 17 had made 3 visits, and 43 had made 4 or more visits).

About 65 per cent felt the need of more effective teaching techniques (laboratory work, class demonstrations, using visual aids, field, and industrial trips). Less than half had had a science methods course. About 50 per cent of the teachers said they always attended the district teachers meetings, 48 per cent said they frequently did and 2 per cent said they never did. About 75 per cent said they attended the science sectional meetings of the state education association (includes those who said "only seldom") and 25 per cent said they never did.

Membership in professional organizations was indicated as follows:

Oklahoma Education Association	192
Oklahoma Academy of Science	18
Kappa Delta Pi	7
National Education Association	6
American Association for the Advancement of Science	6
National Association of Biology Teachers	2
Wild Life	2
Six others (highly technical)	1

The above data indicates a not very hopeful situation in so far as membership in professional organizations is concerned (except as to membership in the Oklahoma Education Association).

Although travel and professional reading constitutes one of the very best means of cultural and professional growth, the indicated amount of travel and professional reading is discouragingly small.

Places Visited

Museums	132
Industrial Plants	83
West	56
Gulf of Mexico	32
Oil Refinery	24
East	18
Chicago	14
Lumber Mill	14
Mexico	13
Carlsbad Caverns	12
Packing Plant	11
Auto Assembly	9
Canada	7
Coal Mine	6
Flour Mill	6
Cotton Gin	4
Bottling Works	3

This would indicate that 84 (nearly 40 per cent) of the science teachers have never visited a science museum, and that 131 (nearly 60 per cent) have never visited an oil refinery—in the oil state of the Union. A very sorry record, to say the least!

PROFESSIONAL READING

Science teachers of Oklahoma are also doing a negligible amount of reading that will promote professional growth. Less than 5 per cent (10 out of 216) take any professional magazine relating to the teaching of science. Many implied that insufficient salary was the reason for not taking more professional reading material. This would seem to be more of a self-excuse than a valid reason. It is very doubtful if an increase of two hundred dollars or five hundred dollars or even a thousand dollars a year would materially increase the professional reading done by science teachers. The cause of the negligence lies deeper than that.

Science Periodicals Taken

Popular Science	43
Popular Mechanics	26
Science Digest	24
National Geographic	23
Nature Magazine	15
Science News Letter	10
Science Leaflet	8
Science Teacher	3
American Biology Teacher	2
Journal of Chemical Education	2
Science	2
Science Education	2
School Science and Mathematics	1
Science Classroom	1

Other Periodicals Taken

Readers Digest	33
American Magazine	22
Colliers	21
Life	16
Time	11
Liberty	10
Saturday Evening Post	9
Look	7

GENERAL SUMMARY

The above investigations indicate that Oklahoma science teachers are not as well trained as they probably should be. This is particularly true in the subject matter fields they are teaching. It is still true that in order to teach chemistry or physics one must know some chemistry and physics. Knowledge is not a result of an inspiration at the moment, as one is teaching. While the average of about 33–36 semester hours in science may loom large, the amount is definitely less than it should be.

Oklahoma science teachers are a mobile group, remaining relatively short periods (average about 1.7 years) in a given school. On the whole, this is surely undesirable.

In general, the more experience a teacher has, the higher the salary. There seems to be little or no relation between size of school and teaching experience. Science teachers need to be prepared to teach in two or three teaching fields. Mathematics is the subject most commonly

taught with science, history second, and home economics third. The teaching load would seem to be somewhat heavier than it should be.

As a whole, Oklahoma science teachers are seemingly making little effort to keep professionally up to date. It would seem that both law and medicine are doing a better job in that respect. We have a right to expect and demand that physicians keep up to date regarding newer practices and discoveries. The public ought to expect and demand the same of science teachers. Few science teachers ever visit another science teacher's class. Surely the knowledge and stimulus resulting from such visitation is being overlooked. Every science teacher should spend a day or more every school term visiting a science teacher in some other school.

Few science teachers belong to any professional organizations except the Oklahoma Education Association. Still fewer science teachers are doing any professional reading in the fields relating to science teaching. If membership in professional organizations and the reading of professional literature is an indication of growth and professional health, then Oklahoma science teachers are in a rather dark age. As indicated above, relatively small salaries are probably not the cause of this lack of keeping professionally up to date. Cost of professional magazines and books is not such a major item of expense as science teachers seemingly assume. The reasons go deeper than that. It is likely the fault of the school systems training the science teachers, the school administrators, and the science teachers themselves. Much of the blame for this condition lies with the administrative staff. A virile, wide-awake administrative staff has professionally up-to-date teachers, and comparatively higher salaries. Money spent by school systems for the professional reading of the teachers probably pays far greater dividends than much greater sums expended for other purposes. Surely either wrong or inadequate training has failed to develop in science teachers a desirable professional morale. More up-to-dateness in professional reading and activities will result inevitably in better salaries.

THE RELATIVE EFFICACY OF TWO METHODS OF TEACHING AGRICULTURAL CHEMISTRY AT THE HIGH SCHOOL LEVEL

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INTRODUCTION

Once a teacher has command of his subject matter his next problem is to select methods of instruction which will bring about the desired results most efficiently. This problem may be subdivided into: (1) Which results are desirable? (2) How can these results be measured? (3) How can these results be compared to determine which method is giving the best results?

Which results are desirable? This question is in part predetermined by the philosophy of the times and the subject matter content. In so far as this is true, the problem is defined by setting down the objectives, general and specific, popularly known as lesson plans. Since good teaching involves purposive learning and meaningfulness at every stage in the process, the original plans must be constantly revised in order to take care of individual differences as they unfold.

How can these results be measured? Until J. M. Rice made the first attempt to

evaluate the effectiveness of instruction [1] in 1892 the method used was presumably subjective appraisal. Immediately following this, in 1908, Thorndike and his students developed the first objective instruments of measurement. Since this time a great many instruments have been devised for measuring comparative human abilities. The test made by the teacher has a better chance of being valid from the standpoint of subject matter actually covered but the standardized test is useful to compare the results with those obtained in other classes.

How can results be compared? A small number of scores can be qualitatively compared by inspection. Where a large number of scores are concerned or where a generalization is to be made from the data the various methods of statistics are essential. A newer method of statistics, the analysis of variance and covariance, obviates the necessity of having matched groups. By this method the differences between groups on one or more basic characteristics are mathematically leveled off and achievement of the groups compared on an even basis.

THE PROBLEM

Essentially the problem was to determine whether farm boys and girls learned chemistry facts and principles and acquired the ability to apply these facts and principles to new problems equally well by the Topical Assignment Method used or by the Discussion Method used.

The differential factor between the two methods was the manner and length of the assignment.[2] The Discussion Group was held responsible for daily assignments. The Topical Assignment Group was given the assignment of the whole unit by means of a problem raising lecture. They were then given references but were not held responsible for a daily assignment.

The experiment was carried out during the fall quarter of twelve weeks, 1941, in the Northwest School of Agriculture and Experiment Station at Crookston, Minnesota, a branch school of the Agricultural College of the University of Minnesota, Minneapolis, Minnesota. Agricultural Chemistry is a curriculum requirement for boys at the tenth grade level and an elective for girls. About ninety per cent of the enrollment of 350 pupils live in dormitories on the campus during the regular school year lasting six months. During the other six months the pupils carry out individual projects on their respective farms. The projects are supervised by members of the school staff.

THE DESIGN OF THE INVESTIGATION

The null hypothesis tested was that there was no difference in the measurable outcomes of instruction when one group of pupils was taught by a topical assignment method and the other group was taught by a daily assignment method.

The subjects of the experiment were two regularly enrolled classes of 25 pupils each in Agricultural Chemistry. The mean Honor Point Ratio of these pupils was 1.29 with a standard deviation of 0.68 while the mean Honor Point Ratio of the two classes of the preceding year was 1.26 with a standard deviation of 0.68. The difference was not significant. The average Kuhlman-Anderson Intelligence Quotient of the pupils of this study was 97.

The basic characters to determine the comparability of the two groups were the previous achievement record, the Kuhlman-Anderson Intelligence Quotient, the initial knowledge of facts and principles of chemistry as measured by a teacher made test and by a standardized test, the Glenn-Welton Chemistry Achievement Examination. Consistently, the differences slightly favored the Discussion Group but in no character was there a significant difference. The means and standard deviations of the

[1] B. Othanel Smith. *Logical Aspects of Educational Measurement.* Ch. 3. New York: Columbia University Press, 1938.

[2] Detailed outlines of the course of study, problem-raising lectures, and assignments are given in the thesis on file at the Library, University of Minnesota.

scores on the tests administered are given in Table I. The performance on the final tests and on the delayed Glenn-Welton test to measure retention are also included.

Both groups of pupils attended the same school, were taught by the same teacher, met in the same room, had access to the same laboratory equipment, used the same textbook, and observed similar lecture demonstrations. The Topical Assignment Group met at 9:05 in the morning and the Discussion Group met at 1:15 in the afternoon. The method to be followed by a class was randomly determined. One group observed the first lecture demonstration of the week first and the other group observed the second lecture demonstration of the week first. This was done to obviate any difference due to the practice of the teacher in presenting the lecture demonstration.

TABLE I

MEANS AND STANDARD DEVIATIONS OF THE TESTS ADMINISTERED

Test	Means		Standard Deviations	
	Topical Group	Discussion Group	Topital Group	Discussion Group
Knowledge of Facts and Principles				
Pretest	20.95	24.26	6.38	7.87
Final	48.35	53.89	12.34	16.31
Glenn-Welton				
Pretest	8.05	8.53	3.09	4.38
Final	27.80	30.00	10.19	18.50
Delayed	22.06	33.09	8.90	22.08
Kuhlman-Anderson	179.15	186.26	20.09	26.13
Application of Principles	14.90	18.84	7.00	10.76

Achievements were measured by the Glenn-Welton Chemistry Achievement Examination, the Knowledge of Facts and Principles Examination, and the Application of Principles Examination. The latter two examinations were designed by the author. The reliability coefficients are given in Table II.

ANALYSIS AND INTERPRETATION OF DATA

The data collected in this experiment were analyzed in four different ways. First, the means and standard deviations of the two groups on the different examinations were compared and tests of significance were applied to the differences between these means and between the standard deviations. Second, the two groups were compared on the basis of their gains on the Knowledge of Facts and Principles Examination and on the Glenn-Welton Chemistry Examination. The significance of the difference in the means and in the standard deviations of these gains was determined. Third, the means of the final achievement test scores were adjusted by the analysis of covariance for inequalities on the basic characters and then these adjusted means compared to ascertain if any significant difference existed. Fourth, the percentage of the final mean score retained by each group on the Glenn-Welton Chemistry Achievement Examination administered after an interval of ten weeks was calculated for each group and these percentages compared.

The differences between the means of the two groups were consistently in favor of the Discussion Group but these differences were not statistically significant. That is to

TABLE II

RELIABILITY OF COEFFICIENTS OF THE ACHIEVEMENT TESTS

Test	Topical Group	Discussion Group
Knowledge of Facts and Principles	0.886	0.919
Application of Principles	0.885	0.93
Glenn-Welton	0.916	0.923

$$r = 1 - \frac{(SD_{o-e})^2}{(SD_{o+e})^2}$$

say, these differences might have occurred due to random errors of sampling. The complete summary of the differences between the means of the final achievement test scores with corresponding critical ratios is given in Table III.

A comparison of the mean gains made by each group shows a significant difference between initial and final performances of the two groups with critical ratios in excess of 6. The difference between the mean gains of the two groups was small and not significant. These differences are given in Table III.

In order to determine whether any significant differences existed between the groups on the criterion measures when the initial status, as determined by the Knowledge of Facts and Principles Pretest and the Kuhlman-Anderson Tests, was held constant, the analysis of variance and covariance [3] was calculated for each of the criterion measures. The test of significance used was Fisher's z-test.[4] By this statistical method the initial differences between the two groups as indicated by the initial tests was mathematically controlled and then the adjusted mean final differences were tested for significance. Tests were made on the differences between groups on the Knowledge of Facts and Principles Final Scores, Application of Principles Final Scores, and the Glenn-Welton Chemistry Achievement Final Scores. In each case the z-value obtained was considerably less than the value of z at the 5 per cent level of significance.

The mean of the Discussion Group on the delayed test was 86.3 per cent of the mean on the final test. The mean of the Topical Assignment Group on the delayed test was 80.5 per cent of the mean on the final test.

TABLE III

COMPARISON OF THE TOPICAL ASSIGNMENT GROUP AND THE DISCUSSION GROUP ON THE BASIS OF FINAL AND DELAYED EXAMINATION MEANS, DIFFERENCES, AND CRITICAL RATIOS

Test	Means		Difference	Critical Ratio
	Topical Group	Discussion Group		
Knowledge of Facts and Principles..	48.35	53.89	5.54	1.17
Application of Principles.....	14.90	18.84	3.94	1.33
Glenn-Welton Chemistry				
Final.....	27.80	30.00	2.20	.45
Delayed.....	22.06	33.09	11.03	1.57

CONCLUSIONS

The following conclusions are based upon the statistical evidence:

(1) Either the Topical Assignment Method or the Discussion Method was effective in bringing about significant gains in the pupil's knowledge of facts and in the applications of these facts to new situations.

(2) Since no statistical significant difference was found between the means of the two groups on the tests purportedly measuring the acquisition of information, the development of ability to apply principles to new situations, and the pattern of outcomes of the Glenn-Welton Chemistry Achievement Test, it is considered that the two methods were equally effective.

(3) For residual learning as measured by the Glenn-Welton Chemistry Achievement Examination the results were inconclusive. The difference in the percentage retained was slightly in favor of the Discussion Group.

[3] Palmer O. Johnson. "Analysis of Covariance Involving Two Independent Variates." Mimeograph. University of Minnesota, Minneapolis, Minnesota.

[4] R. A. Fisher. *Statistical Methods for Research Workers.* London: Oliver and Boyd. 1932. Fourth Edition.

AN EXPERIMENT IN INTEGRATING SEVENTH AND EIGHTH GRADE SCIENCE AND MATHEMATICS

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INTRODUCTION

Need for the Study. The basic relations between the natural sciences and elementary as well as higher mathematics are readily observable. Moreover, the need of every boy and girl, as well as of adults, for knowledge and understanding of the facts and principles usually presented in general science together with the related mathematical concepts and principles is rapidly increasing. This growing social need points directly to the necessity for bringing the two fields of knowledge into closer relation in the act of learning.

Purpose of the Study. This investigation was conducted for the purpose of exploring the possibilities of bringing science and mathematics into closer association in the seventh and eighth grades. The subject matter, in conjunction with certain teacher-learning patterns, constituted the basis of the relations. More specifically, the aim of the investigation was to determine how the integrated plan of teaching seventh and eighth grade science and mathematics compares in effectiveness with the traditional plan of teaching them separately.

NATURE OF CONTENT AND ITS SELECTION

Methods of Selecting Science and Mathematics Topics. The first step in selecting the science topics was a brief survey of a number of the more recently published textbooks in seventh and eighth grade science. Of the textbooks surveyed, one was selected for a basic text. The book selected provided a representative core of science content and presented no particular vocabulary difficulties for the pupils.

The topics in mathematics were selected in much the same manner as those in science. A survey of a number of the more recent textbooks in seventh and eighth grade mathematics was made, and the topics which were common to most of them were selected for use. In addition, a few topics which appeared to be well adapted to particular science units were included.

Content of the Courses. The courses for each grade consisted of the units and topics listed below:

Seventh grade science

I. What are some of the contributions of science to modern living?
   - A. What has science done to contribute toward modern living?
   - B. What part did superstition and fear play in the days before the growth of science?
   - C. Do fear and superstition play any part in life today?
   - D. What does the story of science tell us about the progress of man?

II. Why is water a necessary factor in the environment of all living things?
   - A. What things are absolutely necessary for life of any sort?
   - B. What is the relationship of water to life?
   - C. What is the water cycle?
   - D. Why do some things float while others sink?
   - E. What is water?
   - F. What are the essentials of a satisfactory water supply?

III. Why is air a necessary factor in the environment of living things?
   - A. What is the ocean of air and how may the actions of air be explained?
   - B. What has man learned by exploring the upper regions of the air?
   - C. Of what gases is air composed? Of what importance to us are the different gases?
   - D. How does air sustain life?
   - E. What happens to the carbon dioxide which is released into the air?
   - F. What differences are there between pure and impure air?

IV. In what respects is soil an important factor of the environment?

A. What is soil and how is it formed?
B. What part have natural forces played in preparing soil suitable for the growth of plants?

V. What does energy have to do with changes in the composition of things?
A. What are chemical changes?
B. What are things composed of?

VI. What is heat and how is it used?
A. What is the relationship between heat and other forms of energy?
B. How is heat transferred from place to place?

Eighth grade science

I. How does a knowledge of the solar system help us to explain certain conditions on the earth?
A. Why do the sun and other stars seem to rise in the east and set in the west?
B. Of what is the solar system made up? How does the sun influence the planets, and why do they change their apparent positions among the stars?
C. What are the physical conditions found on the surface of the moon? Does the moon affect the conditions upon the earth?

II. How may different climates and changing weather conditions be explained?
A. What are the differences between our climate and the climate of other lands? What conditions cause these differences?
B. What is the work of the weather bureau and what is the character of the weather in the westerly wind belt?

III. How do plants and animals live in the climates of the different zones?
A. How do green plants live through the changing seasons of the westerly wind belt?
B. How do animals live through the changing seasons of the westerly wind belts?
C. How are plants and animals adapted to live in extremes of heat and dryness?
D. How do living things adapt themselves to life in the ocean and along the shore?
E. How does man protect himself from discomfort and maintain his health through the changing seasons?

IV. What has man learned about the forces that have helped to form the earth?
A. What forces are wearing down the surface of the earth?
B. How is the surface of the earth elevated?
C. Have the changes on the surface of the earth caused changes in climate?
D. What may we learn about the plants and animals that lived in the past?

V. Where does the energy of the world come from?

VI. What do we know about life processes?
A. How do living things use energy?
B. What is the origin of food and how do our bodies use it?
C. How does the human body function and how is it affected by alcohol, tobacco, and drugs?

Seventh grade mathematics

Reading and writing large numbers
Improving accuracy in the four fundamentals
Solving problems
The fraction as a means of expressing ratio
Improving accuracy in the four fundamentals with fractions
Reading and writing decimal fractions
Improving use of decimal fractions in four fundamental operations
Changing decimals to common fractions and vice versa
Finding per cents of numbers
Writing per cents as common fractions
Finding what per cent one number is of another
Finding per cent of increase and decrease
Using per cents above 100
Finding the whole when a per cent is given
Writing percents as decimals
Banking
Interest for one year
Interest for years and months
Interest for days
Mortgages
Installment buying
Finding areas of rectangles
Using the formula in finding area
Finding perimeter
Measuring angles
Measuring land
Locating land areas by township and range
Making constructions with compass and with protractor
Finding the area of a parallelogram
Finding areas of right triangles
Finding areas of any triangles
Find areas of trapezoids
Finding the relation between circumference, and diameter and radius
Finding area of a circle
Finding volumes of rectangular solids and cubes
Reading and making: bar graphs, line graphs, circle graphs, and rectangle graphs
Improving accuracy in use of linear, square, cubic, liquid, dry, and avoirdupois measures
Using metric units—gram, cubic centimeter, centimeter

Eighth grade mathematics

Reading, writing large numbers
Scale drawing
Ratio and proportion
Finding differences in time
Review of percentage, three forms
Review of measures and mensuration

Reading and constructing graphs
Property insurance
Review of fundamentals with whole numbers, common fractions, and decimal fractions
Problem solving
Metric system of length
Conversion of metric to English system of weights and liquid measures
Volume of cylinder and cone
Lateral surface of cylinder and prism
Volume of cylinder and cone
Lateral surface of cylinder and prism
Volume of prism
Trade discount
Finding list price
Multiple discounts
Profit and loss
Finding margin
Stocks and bonds
Taxation
Banking and investments

PLAN OF THE STUDY

The study was conducted in the seventh and eighth grades of the High School Division of the Laboratory School of the University of Missouri during the school years 1937–39. The pupils participating were all regularly enrolled in the respective grades under consideration. Since the emphasis in the seventh grade was chiefly upon the selection of effective instructional procedures and organization of content, complete data on the pupil achievement and progress were not kept. Those that were obtained appeared sufficiently satisfactory to warrant the continuation of the study in the next grade.

General Description of the Groups. In the eighth grade, the forty-four pupils were divided into two equated groups of twenty-two each. One group was designated as the experimental group, the other the control group. The pupils were paired on the basis of the promotion quotient which is calculated from the formula

$$PQ=\frac{MA+EA}{2CA}$$

The mental ages were obtained from the Terman Group Test of Mental Ability, Form A. The educational ages were obtained from the Metropolitan Achievement Tests, Advanced Battery, Partial, Form D. The means of the promotion quotients for the experimental and for the control groups were 115.2 and 115.7 respectively.

The experimental group consisted of twelve girls and ten boys. The control group contained thirteen girls and nine boys.

Experimental Group. The chronological ages of the experimental group in September ranged from twelve years two months to thirteen years eight months. The mental ages ranged from eleven years ten months to nineteen years, with the median at sixteen years six months. The intelligence quotients fell between 96 and 149 with the median at 124. The scores in arithmetic were distributed between grade 6.5 and 9.6. Sixteen pupils were above the norm, grade 8.0.

The initial status and progress in elementary science of both groups were measused by means of the Kansas City General Science Test, Forms A and B. This test has only a ninth grade norm, but it was thought to be the best available standardized test in elementary science for the eighth grade level. The initial science scores for the experimental group extended from 30 to 64. The median was 48.3. Four of the pupils scored above the ninth grade norm of 58.

Control Group. The chronological ages of the control group in September ranged from eleven years eleven months to thirteen years ten months. The mental ages were distributed between twelve years and eighteen years eight months. The median of the mental ages was sixteen years six months. The lowest intelligence quotient was 94 and the highest was 157. The median was 123.5. In arithmetic the range of initial scores extended from grade 6.9 to 10.2.

The scores in science fell between 28 and 78. The median score was 55.5. Four of the pupils made scores exceeding the ninth grade norm.

It is fully apparent that both groups were definitely capable of doing eighth

grade work in science and mathematics. The achievement status in arithmetic was adequate except in four cases.

INSTRUCTIONAL PROCEDURES

The experimental group was taught by the writer. All the material was organized into workbook form and consisted of six units. Each unit was offered as a series of problems followed by a range of activities which were to be performed by the pupils individually or in groups, or on occasion by the instructor as demonstrator. The activities were designed to help solve or clarify the problems which were raised. A limited number of references were also included for the purpose of providing a wider range of information to be used in solving the problems and performing the activities. The pupils were encouraged to propose additional problems and activities or to enlarge on those presented in the assignment outlined in the workbook. The mathematical topics accompanying each unit usually constituted one or more of the activities necessary to solving the problems.

Each unit was introduced by one of two approaches. Most of them were presented to the pupils by way of an overview of the unit and an inventory discussion of the facts and principles involved. On other occasions an indirect approach was made. An event, situation, process, or phenomenon was introduced for discussion and the thinking of the group directed toward the initial assignment of the principal issues of the unit.

Through all stages from introduction to evaluation each unit was developed in the manner which was considered to be most appropriate to the particular unit and to the class. The class discussions, laboratory demonstrations, individual reports, and arithmetic activities were all introduced at what were thought to be the most psychologically advantageous points in the development of the unit. No definite schedule of days for science and for mathematics was followed. The class met for one hour on five days a week.

The control group was taught by another instructor who presented the same science and mathematics content independently of each other, using a basic textbook as a guide for both subjects in the traditional manner. The class met for one hour a day for five days a week.

MEASUREMENT OF RESULTS

Results Obtained in Mathematics. The means of the grade scores of the two groups on the initial test in arithmetic were found to differ only $.17 \pm .173$, as pointed out in Table I. The means for the two groups at the end of the year differed by only $.22 \pm .186$. The standard deviations of the initial means of the experimental and of the control group were .85 and .86 respectively. For the final test the standard deviations were 1.10 and .58 respectively, indicating a wider spread in the scores of the experimental group than in those of the control group. Both groups appeared to make practically a grade in progress as

TABLE I

COMPARISON OF ACHIEVEMENT IN ARITHMETIC MADE BY EXPERIMENTAL AND CONTROL GROUP

	Experimental Group	Control Group	Difference
Number of Cases	22	22	
Mean of Promotion Quotients	115.2	115.2	
Mean of Grade Scores on Initial Test	8.28 $\sigma = .85$	8.45 $\sigma = .86$	$.17 \pm .173$
Mean of Grade Scores on Final Test	9.22 $\sigma = 1.10$	9.44 $\sigma = .58$	$.22 \pm .186$
Difference between Initial and Final Means	.94	.99	

evidenced by the differences between the means of the initial and final scores for the respective groups.

Results Obtained in Science. Because of incomplete returns on the science tests, fourteen pupils from the experimental group were matched with fourteen pupils from the control group to form a basis for comparing the progress in science resulting from the two plans of instruction. The data are presented in Table II. The mean of the initial scores was 49.4 for both groups. For the final scores the mean of the experimental group was 62, while the mean of the control group was 59. The difference between the means was 3 ± 2.55 which would indicate that there was no significant difference in the amount of achievement made by the two groups.

TABLE II

COMPARISON OF ACHIEVEMENT IN SCIENCE MADE BY FOURTEEN MATCHED CASES FROM EXPERIMENTAL AND CONTROL GROUPS

Initial Test		Final Test	
Exper.	Control	Exper.	Control
30	28	39	37
36	36	52	66
39	39	64	62
42	42	76	50
48	48	68	47
48	49	50	62
50	50	68	56
50	50	62	59
53	54	59	63
56	56	73	64
58	58	73	51
59	58	48	69
60	61	63	63
62	63	72	74
Means 49.4	49.4	62	59

Difference between final means 3 ± 2.55

$\sigma = 10.66$ $\sigma = 9.38$

GENERAL OBSERVATIONS

Although the results cannot be considered statistically reliable because of the small number of cases and the conditions under which the study was conducted, they do permit of certain observations which are offered here.

1. There seems to be no appreciable difference between the effectiveness of the integrated plan and of the traditional plan of presenting seventh and eighth grade science and mathematics especially under conditions such as those obtaining in this study.

2. The results would seem to indicate that five periods per week are possibly sufficient for normal progress in seventh and eighth grade science and mathematics under conditions similar to those present in this study.

3. It appears possible to integrate with the topics usually included in seventh and eighth grade science practically all the topics commonly presented in a course in seventh and eighth grade arithmetic.

REGIONAL MEETINGS OF THE N. A. R. S. T.

Three regional meetings of the National Association for Research in Science Teaching have been planned as follows:

Feb. 28–Mar. 1—University of Chicago, Robert Havighurst, Chairman.

Mar. 18—Teachers College, Columbia University, New York, Florence Billig, Chairman.

Apr. 15—Cleveland, Ohio, Arthur O. Baker, Chairman.

STATE-WIDE TESTING PROGRAMS

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Teachers and school administrators at all levels of our educational system will be interested to know that state-wide and regional testing programs are continuing to be widely used. The functions and advantages of these programs are many. They bring the cost of an adequate testing program within the reach of every school; promote wholesome comparisons; assist in guidance and personnel programs; and improve the articulation between various levels of the educational system. It is not the purpose of this paper to praise, recommend, and applaud the state-wide and regional testing programs but merely to familiarize those who are interested in their possibilities with the extent to which they have been used in the past and the extent to which they are used today. Many colleges and universities are sponsoring these state-wide programs for it is not only a valuable service for them to render but it assists in the improvement of articulation between the secondary schools and colleges. Therefore it is with special interest that the institutions of higher education should review the present status of these testing programs.

Inquiries were directed initially to the Office of Education in each state, asking whether or not any state-wide testing program had ever been conducted and whether any such program was now in existence. No long, exhaustive questionnaire was sent, but instead the object was to make a few direct inquiries knowing that further, more detailed investigations could follow. When interpreting the returns, one must keep in mind that it is barely possible that some of the persons to whom this inquiry was directed may not have been as familiar with the testing programs of their state as they might have been.

Letters of inquiry were sent to all of the states on November 1, 1942, and follow-up letters were mailed at intervals to those states who failed to respond. Four separate requests still failed to obtain returns from two states: Alabama and Georgia.

The findings may be summarized quite briefly. It appears that twenty-eight (58 per cent) of the states have had some kind of a testing program, but that only nineteen (40 per cent) now have such programs operating. Thirteen of the nineteen states with testing programs use them wholly or in part for improving the articulation between high school and college, while others administer tests either in the schools which are not accredited, or for elementary and eighth grade programs. The term "state-wide" is a misnomer in most cases, for while the services are in nearly every instance made available to all the schools, only eight states claim that all of their schools participate. In twelve of the states, all or part of the tests used are available through commercial agencies, while only four construct all or part of their tests through the cooperative effort of the teachers in the state. Of the nineteen states with current testing programs, only Washington (with an elementary school program) indicates that no single agency is responsible for the administration of its testing program. In ten instances, departments in colleges and universities are said to assist in this testing and evaluation.

The accompanying chart (Table I) gives an abbreviated summary of the findings from this survey. The name of the person or agency who directs the program is also given so that the readers may know to whom they should direct their inquiries. A somewhat more detailed summary of the findings of this survey can be obtained from the writer by anyone interested.

* At present on Examinations Staff of the U. S. Armed Forces Institute, Univ. of Chicago.

TABLE 1

STATUS OF STATE TESTING PROGRAMS

States Having Had State-Wide Testing Programs at One Time or Another	*With Testing Programs Now Operating*	*Intended for Improvement of Articulation Between Secondary School and College*	*Using Commercial Tests*	*Some Tests Prepared Through Cooperation of Teachers*	*Departments in College and University Supervise Part or All of Program*	*Name of Person or Agency Directing Program*
Arizona						
Connecticut	X		X		X	1
Delaware	X		X			2
Florida	X	X			X	3
Idaho	X					
Indiana	X	X		X	X	4
Iowa	X	X	X		X	5
Louisiana						
Maine	X	X	X		X	6
Maryland	X		X			7
Michigan	X	X	X		X	8
Minnesota	$X_{1,2}$	$X_{1,2}$	X_2	X_1	X_2	9
Montana						
Nevada						
New Hampshire	X	X	X			10
New Jersey						
New York	X	X				11
North Dakota	X	X		X		12
Ohio	X	X		X		13
Oklahoma						
Oregon						
South Carolina						
Tennessee	X	X	X		X	14
Texas	X	X	X		X	15
Virginia						16
Washington	X		X			17
Wisconsin	X	X	X		X	18
Wyoming	X					19

Person or agency directing program:

1. J. R. Gerberich, Univ. of Conn., Storrs, Conn.
2. R. L. Herbst, State Dir. of Res., State Dept., Dover, Delaware.
3. Univ. Examiner, Univ. of Florida, Gainesville, Florida.
4. H. H. Remmers, Purdue Univ., Lafayette, Indiana.
5. E. F. Lindquist, Univ. of Iowa, Iowa City, Iowa.
6. J. W. Crawford, Univ. of Maine, Orono, Maine.
7. State Supervisor H. S., State Dept. of Educ., Baltimore, Md.
8. Clifford Woody, Dir. Res., Univ. of Michigan, Ann Arbor, Mich.
9. (1) O. R. Sande, State Dept. of Educ., St. Paul, Minn.
   (2) John Darley, Dir. Test. Bur., U. of Minn., Minneapolis, Minn.
10. Walter M. May, State Dept. of Educ., Concord, N. H.
11. Harold G. Thompson, Dir. Exam., State Dept., Albany, N. Y.
12. Ella Schraeder, Dept. Public Instruction, Bismarck, N. Dak.
13. Ray G. Wood, State Dept. of Educ., Columbus, Ohio.
14. R. F. Thomason, Registrar, Univ. of Tenn., Knoxville, Tenn.
15. H. T. Manuel, Dir. of Res., Univ. of Texas, Austin, Texas.
16. C. E. Myers, State Dept. of Educ., Richmond, Virginia.
17. No single agency responsible.
18. Curtis Merriman, Registrar, Univ. of Wis., Madison, Wis.
19. Div. of Spec. Educ., State Dept of Educ., Cheyenne, Wyoming.

SCIENCE FIELD TRIPS IN THE ELEMENTARY SCHOOL

DOROTHY E. WHEATLEY
Elementary Science Consultant, Public Schools, East Orange, New Jersey

Often children in elementary schools are more aware of their immediate environment than are their teachers. Many a child has remained awake at night to watch the stars; has built soil ridges to disturb ant colonies; has climbed trees to examine birds' nests; has spent hours searching for different kinds of rocks; has come late to school because of the fascination of a steam-shovel. Teachers have a responsibility to capitalize the too-infrequently ignored observations that children make. Children's interest in their surroundings may be effectively used in teaching science. Trips taken by a school class constitute a common basis on which science understandings may be built.

Sometimes children's questions can best be answered by a field trip. Questions about stars are likely to be of this sort. A child may have noticed a red star shining brilliantly in the black-out one night. The next day he tells about it in school and asks, "Was that the North Star?" When he is told that the "star" is a planet, he wonders whether or not there are living things there. He also wants to know which star is the North Star about which he has read. Obviously, an excursion into the out-of-doors is in order.

It is preferable for children's star trips to take place at an early hour and at a time when the sky contains some of the more familiar constellations. In winter, East Orange children usually meet for star study at seven in the evening. The children understand that the observations will begin promptly at seven and will stop exactly one half hour later. Strict adherence to this schedule pays dividends in cooperation from parents. Parents, incidentally, are invited to accompany their children. This practice has occasionally led to the offer of a telescope for use in follow-up work.

If planets are visible—and they usually are—their position should be noted in relation to some brilliant stars or well-known constellations. A few weeks later, when the children observe the sky at exactly the same time in the evening, they will be interested in noticing that the planets are not in the same location, but have moved.

It is usually better to identify Orion first in winter time, rather than to concentrate on the Big Dipper, for the Dipper is not as clearly defined as many books would lead one to think. After the children have found the three stars in the hunter's belt, it is easy for them to locate the red and blue stars which are at either extreme. This observation affords an excellent opportunity for a brief discussion as to why astronomers speak of stars as having different colors. The discussion should be followed by reference work in the classroom the next day.

Children often ask about the bright star Sirius (although not, as a rule, by name) and are impressed when they learn how long ago its light left the star. Children are always anxious to find the North Star. Apparently they have read quite a bit about it. Unfortunately, many books mislead both children and adults into thinking that the North Star is especially brilliant. Unless the evening is unusually clear, it may not even be discernible in the handle of the Little Dipper. The difficulty in locating this famous star is likely to be a memorable part of the evening.

A few observations are enough for one evening. It is better for children to learn a little than to become confused by many details. It is true that they will ask about unfamiliar star groups, but it is equally

true that the majority of the class will forget them soon after their identification.

Most field trips, of course, are taken during the day. For younger children a short trip around the school yard may be a rich learning experience. In autumn the children will probably raise questions such as these:

Why does a tree have leaves?

Why are there so many different kinds of leaves?

What are leaves good for?

Their questions may lead to class discussion, reading, and experimentation. Other observations, too, may lead to further work. Children may see birds flying south, ladies wearing winter coats, boys playing football, seeds of dandelion and milkweed sailing through the air. Discussion of seasonal changes, can initiate interesting science study.

Similarly, much scientific information can be gained on a trip around the block. The smooth surface of a concrete pavement may be contrasted with the rougher surface of natural rock pavements. Perhaps truckmen may be seen moving heavy loads down an inclined plane. Cloud formations are readily observable from the street. Different types of airplanes are sometimes seen in the sky. A house surrounded by barberry bushes is a reminder that birds feed upon berries and are likely to frequent the shrubs that bear them; thus the householder is benefited, for birds also eat insects which might harm the victory garden. A terrace planted with grasses and shrubs is an illustration of a method of erosion control; it is easy to see that the plant roots are holding the soil in place.

In an empty lot there may be rocks or large stones. Under these there is usually a variety of life. When they are raised, centipedes and millipedes may be seen to scamper away; ants may be observed to gather their pupae and scurry off; sow bugs and slugs may be found by careful seeking. Children will notice that the grass under the rocks differs from that around them, for it is a dull yellow color and is moist even when other grass is dry. Often children want to raise the largest rock that they can see. When they find it extremely heavy, they may try to think of some device that will help them move it. Sometimes a study of simple machines has grown out of this experience.

More extended field trips are appropriate for older youngsters. For example, there are several basaltic quarries near East Orange, to which the children of the elementary schools may conveniently be taken. The children are familiar with trap rock from these quarries, for it is used in the neighborhood as gravel in driveways and as ballast for railroad tracks. When they visit a quarry, they learn the source of this stone. Not only do they see the igneous rock, but they also observe red sandstone, the basic rock in the vicinity. They notice that the surface of the softer sandstone is at a lower level than that of the basalt. They find many evidences of erosion as well as of weathering. The children may be helped to realize that much of this wearing away of the earth occurred a long time ago.

The same quarry has an abundance of pond life which in the spring may be used to study the interdependence of plants and animals. By digging into the mud the children find dragonfly nymphs and pollywogs. By scooping the water from the surface of the pond they can gather duckweed. By watching overhead, they see insects such as the damsel fly. On several visits the water in the quarry pond has been discolored, and the children have learned how human beings sometimes intervene in the balance of nature; in this case by placing oil on the water, they prevent an increase in the mosquito population.

In addition to the many opportunities for learning provided by a field trip, preparation for the trip affords many learning experiences. Before the children can go to the quarry, they must obtain permission from its owner. Then, too, they write to

the officials of the bus company, informing them of the large number of extra passengers who will board a certain bus on the day of the trip. They decide what they will consider good manners en route to their destination and what actions they will avoid. They discuss the rules of the road, for a part of the time they will be walking along a highway which is not bounded by a foot path. They make collecting equipment that they think will prove useful on the trip. If they intend to spend noon hour at the quarry, they plan a nutritious picnic lunch.

After the children have visited the quarry, they are always interested in rocks. They want to know more about how they were formed. Fortunately, the city adjacent to East Orange (Newark) has an excellent museum which they can visit. The Newark Museum has a splendid exhibit of igneous, sedimentary, and metamorphic rocks; not only are specimens shown, but there are graphic illustrations explaining rock formation.

A trip to the museum is always of interest to children. Almost invariably they share their reactions with their parents. Many parents accompany their children on subsequent visits to the museum, and have expressed their pleasure at learning of the advantages it offers.

There is no doubt that field trips can be powerful contributive factors in children's learning. These excursions offer children experiences they long remember, experiences that are a vital part of their lives.

WHY TAKE FIELD TRIPS?

RACHEL S. BRUCE
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A five year old boy came running into the house. He was very much excited. "Oh, Mummy, we just saw the most 'curiosest' creature. He didn't have any legs and he went like this. He stuck out his tongue at me and went S-S-S, when I picked him up." We, the teachers of children like this boy, are trying to train them to see, to observe carefully, to think about what has been observed, to express their thoughts clearly in simple direct language and to ask questions. Here was a child, with no school training, seeing, observing, experimenting, questioning and sharing.

Children, when they enter school are ready and eager to learn about the things they see around them. Often the school atmosphere seems to deaden this eagerness to find out. Questions come less frequently. Things stop finding their way into the classroom because the bringing in of caterpillars, frogs and snakes was discouraged; and bright leaves, curious seeds and interesting stones made the room untidy. Children stop telling about their outdoor experiences because there just didn't seem to be time.

We must keep the children's eager curiosity alive. One of the best ways to do this is through trips. Children talk more naturally when out-of-doors. When on a trip with the teacher they notice things not seen before and ask questions about them. They see things in their natural setting and can more easily draw correct conclusions. Outdoor study is more natural. It is real, alive and changing. To understand the larger world with its many complications, children need to be well acquainted with their own back yards first. This can be done best through letting the children study out-of-doors, training their eyes to see, their ears to hear, and their minds to think about what is being observed.

Trips and study in the field should be one of the outstanding activities in science throughout the year. I am sure many of you have your own technique for carrying on an excursion. But for those who are a little timid about taking the class out of the building I am going to outline my plan. A nature or science trip is different from trips to bakeries or farms, unless it is a trip to a weather bureau or airport during the study of weather, or to a museum to see collections, in that you cannot foretell exactly what you are going to see. But this does not mean you just go. There are three steps to any excursion:

1. Careful preparation for the trip.
2. Flexible procedure during the trip.
3. Follow-up work after the trip.

The teacher must be sure that the trip will help the children to see more clearly or appreciate more deeply that which is being studied. She must go over the ground to be able to help the children see everything that they should see and to be forearmed against questions. If there is any unusual phase to the trip, such as a bus ride, payment of fee involved, written permission from the parents should be obtained. If we are going into the woods I merely announce the trip, so that the parents will know where the children are.

In preparing the children for the trip, safety rules to be followed strictly are made by the children and teacher together, and courtesy rules are discussed. The purpose of the trip is made very clear, by getting the children as far as possible to say what they are going to do and sometimes even putting it down on paper. Every child should be responsible for some part of the study. Older children should be held responsible for a question. If a class book or exhibit is to be assembled after the trip, one part of the project should be in the charge of a child or group to be sketched, written or collected. Permission notes from parents, arrangements for money, equipment or materials needed must be attended to in advance.

Arrange carefully how the children are to get to the place which they are to study. Have responsible leaders and a group of end men. I always walk at the front of the line. The children have partners. Just before starting review courtesy and safety rules. Unless it is a "conducted" tour, allow freedom within the bounds of courtesy and safety so that the children's experience may be rich. After the trip, check carefully the responsibilities of groups or individuals. Let the class judge with you if each has met his responsibility. Assemble all findings. Discuss briefly whether the safety and courtesy rules were followed adequately. Write notes of appreciation to people who have helped on the trip.

Here are some of the trips that I have found practical and enriching. I have listed these according to seasons, but they do not necessarily have to be taken in this order nor all in one year. The class, the program, the weather, and variable conditions in seasons from year to year guide me in my selection. In the fall we go to meadows and fields, roadside and brookside to study and collect fall wild flowers. We visit gardens to study flowers, and sometimes we visit a greenhouse. We study trees in the school yard, along the road or in the woods. One year we each adopted a tree and watched changes in our tree through the year. We listed what animal life came on or near the tree. This activity necessitated several visits. We have taken a trip to a farm to see the activities during a particular season. We have visited a truck farm, a fruit farm, and a dairy farm.

After building the aquarium it must be stocked. This calls for a trip to the pond. There may also be a trip to the brook for purposes of comparison, though animals from the pond thrive much better in an aquarium than animals from the brook.

There are the trips to collect seeds for collections, charts, booklets, or pretty tea plaques. When ferneries to brighten the room during the winter months are being

made, trips to get the flowering plants, berries, and mosses and lichens for them are necessary. Birds' nests are being collected for the purpose of making habitat groups. The fall of the year is the best time for this. Insects can be studied best out-of-doors as it is difficult to keep them alive indoors. Where do we find the greatest variety of fungi? Only study in the field can answer this question on the elementary school level.

What greens may we use for Christmas decorations? Where may we collect them? A trip is taken to gather these greens. There are winter trips to find bird and animal tracks in the snow; to study snow crystals; to hunt for birds' nests, insect eggs, cocoons, and chrysalises. A bird-feeding station or animal sanctuary may be maintained during the winter months. This necessitates groups visiting the station at least twice a week.

During a study of weather or air, trips to study clouds, winds, gliders, parachutes, and activities at an airport are valuable. Problems of erosion must be studied out-of-doors where the effects of erosion can be seen and watched. Blazing a nature trail includes many of the activities listed.

In the spring, trips similar to those in the fall may be taken to notice or watch changes; to gather unfolding buds; to collect small budded plants to replenish the ferneries, to see gardens gay with flowering bulbs and other early garden flowers; to collect spring wild flowers; to see and perhaps collect the new life in the pond and brook. Spring is the time of the year for the concentrated study of birds. This will call for several trips as the groups should be small.

There are interesting trips to the departments in the city, which are working to safeguard our health, *e.g.*, the City Water Department, the sewage disposal plant and Health Department. Trips to museums, Natural History Rooms, the airport, a power plant and a garage are all valuable, if there is a definite and understood purpose for the trip. A few well planned excursions, where you call the children's attention to something not noticed before will do more toward setting children investigating for themselves than dozens of lessons in the class room. Trips help develop an inquiring mind. One of these trips may be the beginning of a lifelong interest or hobby for some child.

A FOOD UNIT

M. GATES AND I. SHANNON
Students in Training at Horace Mann School, Salem, Massachusetts

Teacher asks the class to list foods that they have eaten for lunch, and tell where each food comes from. Example: bread, wheat plant; butter, animal product; peanut-butter, peanut plant; milk, animal product; apple, fruit of tree.

Note these facts:

More food from plants than from animals.

Greater variety of plant than of animal food.

We use more parts of plants than of animals.

What part of the plant is used more than any other for food?

Berries and citrus fruits like oranges, lemons, etc.

Seedlike fruits, such as wheat, oats, and barley.

Seeds, such as peas and beans, and nuts.

Roots, and underground stems of plants, such as potatoes, beets, and turnips.

Stems, such as sugar cane and asparagus.

Leaves of plants, such as spinach, or lettuce.

Buds and flowers, such as cauliflower and Brussels sprouts.

Source of animal products is green plants.

GREEN PLANTS MAKE THE FOOD OF THE WORLD

Experiment:

Purpose: To show that plants make food.

Materials: A leaf from a healthy plant, beaker, tripod, Bunsen burner, wood alcohol, iodine solution, corn starch. (Iodine solution made by adding a few crystals of iodine to 95 per cent alcohol.)

Procedure: Boil a leaf in water, place in hot wood alcohol to take green coloring out of it. Wash the leaf carefully and put in an iodine solution. Put corn starch in a bit of iodine solution. It turns blue showing presence of starch. Compare with the leaf put in iodine solution.

Conclusion: Leaves exposed to sunlight contain starch. Therefore, green plants make food.

Foods classified according to nutritional value:

Fuel foods.

Body-building foods.

Regulative or protective foods.

Other food classifications:

Carbohydrates—Composed of carbon, hydrogen, and oxygen. The hydrogen and oxygen in the ratio found in water.

Fats and oils—Composed of carbon, hydrogen, and oxygen, but in different proportions.

Proteins—Composed of carbon, hydrogen, and oxygen, plus nitrogen.

MANUFACTURE OF FOOD

Teacher. What is responsible for all the food made in the world?

Pupil. Plants—although we eat meat from animals, these animals depend upon plants for their food.

T. Plants are the only things that are able to change inorganic substances into living matter. Can you explain the process?

P. Roots take water from the soil, and with the water they take minerals which are dissolved in it. The water passes up through the stems to the leaves. In the leaves are tiny openings through which the air enters, and in the air is a gas called carbon dioxide. The leaves contain a green substance called chlorophyll which with the aid of sunlight as energy, combines the water and carbon dioxide into carbohydrates.

T. What is this process called?

P. Photosynthesis.

T. This may be compared to the manufacturing process. Can you make the comparison?

P. Factory—Green leaf. Work rooms—Cells in the leaf. Machinery—Chlorophyll. Energy—Light. Raw materials—Soil water and carbon dioxide. Products — Carbohydrates. By-product—Oxygen.

Draw a diagram showing the process of photosynthesis.

CARBOHYDRATES

Purpose: To show that our food contains energy necessary for the activities of the body and to find out which are the best energy foods.

Procedure:

T. What gives a locomotive the power to go? A ship? An automobile? A street car? An airplane? Can you think of any other kind of engine?

P. The body.

T. What gives the body engine power to go?
P. Food.
T. How? How does gas or oil give other engines power to go?
P. By burning.
T. Does food burn in the body with a flame? No, but it gives off heat. Feel your cheek. It is warm. Food gives heat and power. In order to have the power to walk, run, etc., we must keep our body supplied with food. There are different classes of food. What are they?
P. Carbohydrates, proteins, fats, mineral matter.
T. Starches and sugars are carbohydrates. Perform experiment 1 (explained at end of lesson). Perform experiment 2 (explained at end of lesson). We see that there is starch in plants. Plants are the source of all of man's food. Can you name some other foods which contain starch? Test foods for starch—Potatoes, fruit, bread, etc.

Preparation of potato starch

Lay a piece of cheese cloth in a pan of water. Grate a potato upon this. Squeeze the pulp in the cloth and catch the water. The starch granules are in this water. After a second wetting and squeezing let the liquid stand. The sediment which is starch collects at the bottom. Drain off the water and dry the starch. Test a little of this with iodine.

T. From what foods do we get sugar?
P. Jellies, puddings, honey, syrup, candy, molasses, fruit, etc. Perform Experiment 3.

Experiment 1

Place a small amount of starch in a test tube full of water. Heat gently.
Put a few drops of iodine solution in the test tube. The solution will turn blue.
On the basis of this result other foods can be tested for starch by the application of a few drops of iodine.

Experiment 2

Obtain several leaves from a healthy plant which has been exposed to direct sunlight for several hours. Boil the leaves for a few minutes in water and then boil them in alcohol until they are nearly white. Place the leaves in water again and heat until they are soft. Test for starch.

Experiment 3

Place a small amount of Karo in a test tube. Add a small amount of water. Heat gently until the Karo is mixed with the water. Add 5 cc. of Fehling's solution and heat. A brick red color indicates grape sugar.

PROTEIN

Purpose: To show that certain foods contain protein which the body must have in order to grow:

Procedure:

T. If we decided to have a garden what would we do first?
P. Plant seeds so that the flowers or food will begin to grow.
T. How could growth start simply by placing such a small thing as a seed in the ground?
P. Moisture softens the shell. Sun warms the earth. The baby plant breaks through its cover. Growth starts.
T. Once growth has started what must the plant have, what must anything have, in order to continue to grow?
P. Food.
T. Where does the baby plant get this food? Is it provided by the air, the earth and aided by the sun?
P. Not at first. It gets the food from inside the seed case where it has been stored by the mother plant.

The teacher will sketch the process of growth. In the beginning the food is sent to the root. Then the stem pushes out through the case and then through the soil.

T. Here is a seed and a similar seed case which is empty. What is missing from the case?
P. The food and the plant.

Review the process—First there is the mother plant with its flower. Inside the flower is the seed, inside the seed is a baby plant, and inside the baby plant is the food it must have to grow. The name of the food is protein.

Place a sectional diagram of a fruit blossom, ovary and seed on the board. Label the *flower, seed* and *baby plant.*

T. What seed foods do we eat?
P. Wheat, rye, oats, beans, peas and nuts.
T. What are in seeds?
P. Food for growing.
T. There must be protein in any food that can become a living and growing thing. What other foods besides seeds can become something that lives and grows?
P. Eggs.
T. What do babies eat to help make them grow?
P. Milk.

Cheese also contains protein—it's made from milk. Show chart of protein foods.

T. Proteins help growth, but why should people who are fully grown eat protein foods?
P. In order to do work especially strenuous work a person must have muscle. The material that muscle is made of and that helps keep it in good condition is the protein foods. Also everything that is used at all must be repaired or it wears out. The same holds true for the body, so that protein is necessary to keep the body—flesh and muscle—in good condition.

Experiments: Test foods for protein.
Materials: Test tubes, nitric acid, dilute ammonium hydroxide, egg-white, sugar, salt, cornstarch.
Directions:
Part 1:
In four test tubes place egg-white (a protein), sugar, salt, and cornstarch.
Into each test tube pour a little dilute nitric acid (Caution), heat gently, and watch results.
Which food becomes yellow in color?
Now add to the mixtures in the test tube a little dilute ammonium hydroxide.
Which food becomes orange in color? The egg-white was the only one to change color. This color change indicates the presence of protein.
Part 2:
Place each kind of food to be tested in a separate test tube; add nitric acid; heat gently; and add ammonium hydroxide.

CALCIUM

T. After the workmen have built the basement or foundation, and before they can go ahead and put in the walls, floors, and ceilings in a building, what must they do first?
P. They must have a framework.
T. What holds the various pieces of automobiles or planes together, and gives them shape?
P. The framework.
T. What special name is given to the framework of the human body?
P. The skeleton.
T. Of what is it made up?
P. Bones.
T. What have we in our food which helps to make bones? When a child is first born he can't stand of his own power. What happens as he grows older to give him this power? What is a child fed when it is very young?
P. Milk.
T. So there must be something in milk which helps the bones harden and grow. Does anyone know what this substance is?
P. Calcium.
T. What is calcium? Have you ever seen it? (Show powdered lime, shells, coral, piece of marble.) Is there anything in your body which looks like this marble?
P. Teeth, bones and there is calcium in them.
T. Where do we get calcium for our body?
P. Milk (every child should have at least four glasses a day).
T. Have a tray of other foods containing calcium—cheese, eggs, leafy vegetables, dark bread, cereal, oranges, beans, carrots, turnips.

Experiment to show that calcium is present in foods.
Materials: Two bottles; one of water (clear), one of limewater.

Procedure: These look the same. Blow through pipette into clear water, no change. Blow into limewater, looks milky.

T. The food chemist can show that the foods displayed on this tray contain calcium just as easily as we have shown that limewater contains calcium.

T. What happens when a person doesn't get enough calcium?

P. Legs become bowed, bones aren't strong, teeth decay.

Test for mineral matter in foods:
All organic matter burns. Place food to be tested in an iron spoon and heat over a Bunsen burner until the organic matter is all burned. The ash which is remaining is mineral matter.

IRON

Purpose: To show that iron, as it is obtained from food helps to make the red blood which is essential to good health.

Procedure:

T. How does the water get from the reservoir to you?

P. Through a system of pipes. The large ones to the town, others to the streets, small ones to the houses.

(If possible get a map of the local water system and pictures.)

T. In every one of us there is a similar system, what is it?

P. The circulatory system, pumping blood to and from the heart. The large pipe is the aorta, the smaller ones the arteries, and still smaller ones the capillaries.

(Show chart of the circulatory system.)

T. What color is blood? What makes this color?

P. Air drawn in with every breath supplies oxygen. Another substance necessary to make red blood is iron.

T. Where do we get iron? (Food.) Which are the foods richest in iron?

P. Vegetables, fruit, molasses, meat, gingerbread.

T. Why must our blood be healthy?

P. It carries oxygen and iron to every part of the body. It carries all food material which the body uses to build its cells, flesh, muscles, bones, teeth, and to give power and energy.

FATS

T. There is a class of food similar in content to carbohydrates. Of what are carbohydrates composed?

P. Carbon, hydrogen, and oxygen.

T. Fats contain these same elements but there is a larger proportion of carbon in fats than carbohydrates. They are probably made in plants from sugars and starches that have already been formed. They are also produced in the cells of animals.

Test for fats:
Put a few drops of olive oil on a sheet of brown paper. Notice the character of the spot formed.
Heat the spot. The paper becomes translucent to a certain degree.
This same test can be performed with other foods.
Perform Babcock test to show the fat in milk.

Outline of other material to be covered:
Water
65 per cent of human body water.
Function: Carrying of food; removal of waste.
Amount needed: Dependent on climate and occupation.
Requirement per day.
Foods containing the largest amount of water: Fruits, Vegetables, Milk.
Test for water in foods.
Vitamins:
What are vitamins?
How are they named?
What effects do they have on the body?
In what foods are they found?

HOW FOODS ARE USED

People eat the foods that grow around them.
Early settlers ate food brought with them; later things they could grow.
Arabs eat dates, figs, meat of goat and sheep.
Importance of a varied diet.
Green vegetables are essential.
Body compared to an engine.

Certain kinds of foods burn better than others.

Experiment:
Purpose: To show that certain foods burn better than others.
Materials: Pieces of bread, meat, and fat, a Bunsen burner.
Procedure: Burn a piece of bread, meat, and fat. Compare the way they burn.
Conclusion: The fat burns best. Thus fats make the best fuels.

Sugar is a fuel food.
Candy is a fuel food, but doesn't contain any mineral and regulative materials.
Activity: Have children figure out how much candy they eat in a year. How much does the whole class eat?

The growth foods.
Proteins are necessary for building living matter.
Foods containing protein such a lean meat, beans, peas, eggs, cheese, fish and nuts.

Protective or regulative foods.
Recent discoveries in foods have proven that vitamins are necessities for good health.
Certain mineral substances found in milk and water are also necessary.
Bran, some vegetables and fruits, are necessary bulky foods.

CARE OF FOODS WITHIN THE HOME

What causes food to spoil?

Experiment:
Purpose: To show action of bacteria, yeasts, and molds.
Materials: Solution of molasses and water (one part of molasses to five parts of water), two cups; two slices of bread; two jars with covers.
Demonstration: Put molasses solution in two cups; one exposed to the air in a warm place, the other near the ice in an icebox. Observe differences in odor, taste, and appearance of contents of two cups from day to day.
Moisten slice of bread, expose to air for short while, place in jar, and cover tightly. Keep bread moist and in warm place. Place a slice of dry bread in other jar and cover tightly. Observe differences in appearance of contents of the two jars from day to day.
Conclusion: Under certain conditions foods spoil due to the action of bacteria, yeast, and molds.

Changes in food caused by microorganisms.
Bacteria must have dead or living foods to live on.
Sometimes give up poisons as result of growth.
Yeasts and the work they do.
Process of fermentation takes place under condition of warmth and moisture.
Sugar and starches broken down into carbon dioxide and alcohol.
Molds are a common food enemy.
Attack foods, shoes, leather, paper, or moist wood.
Give certain cheeses their flavor.
Types of bacteria.

CARE OF FOODS WITHIN THE HOME

How to keep foods from spoiling.
Cooking destroys living organisms in food. Sterilization is used in canning.

Experiment:
Purpose: To show unfavorable temperatures for the growth of microorganisms.
Materials: Three cups, small number of beans.
Demonstration: Soak beans, put equal number in three cups containing small amount of water. Put one on ice, one in moderately warm place, and the third in the oven or exposed to high heat. Keep amount of water in cups the same every day. Observe daily.
Conclusion: Extreme cold or warmth are unfavorable for growth.

A cold temperature is unfavorable to bacteria.
Intense cold prevents growth, but does not always kill bacteria.
Refrigerators or iceboxes keep foods from spoiling.
Construction of the refrigerator.
How we use the refrigerator.
Electric or other methods of refrigeration.
Advantages of carbon dioxide, or "dry ice."
The iceless refrigerator.

Other preservatives.
Salting of pork, beef, and fish to prevent spoiling.
Pepper, spices, and sugar and their part in food preservation.

MILK, THE PERFECT FOOD

Milk contains proteins, fats, and carbohydrates, and is the most important body-building food.

Most of the protective vitamins are in milk.

Milk should always form a part of the day's food supply, and children should have at least one quart a day.

Effect of milk in diet of animals.

Experiment:

Purpose: To show effect of milk in diet of rats.

Materials: Two white rats of equal size, cages, ration containing milk, bread, and cabbage, water.

Procedure: Weigh the rats and record their weights. Place them in adjoining cages under the same conditions of air, water, and sunlight. Feed one rat on a weighed ration of milk, bread, and cabbage. Give the rat the same amount of weight of bread, cabbage, and water. Weigh the two rats at the end of one, two, and three weeks. Note the differences in weight. The rat fed on the ration containing milk weighs more.

Conclusion: Milk has an effect on the diet of rats.

Milk is ideal for the growth and reproduction of bacteria.

Great care necessary in order to keep milk pure.

Pasteurization used to kill bacteria without injuring milk.

Experiment:

Purpose: To show how milk is pastcurized.

Materials: Two test tubes, raw milk, clean absorbent cotton, beaker.

Procedure: Fill each of two test tubes half-full of raw milk and plug both tubes with clean absorbent cotton. Place one tube in a beaker of water and heat it to 145° F. for 25 or 30 minutes and cool it in cold water. Set the two tubes aside so that they will both be under the same conditions of temperature. Examine the tubes at intervals of 24 hours for three or four days, and note the taste and odor of each.

Conclusion: Milk may be pasteurized by heat.

The inspection and grading of milk.

If the school has a Babcock Tester the test can be conducted to show that different types and brands of milk have different per cents of fat content.

ACTIVITIES FOR NATURE CLUBS

GERTRUDE B. GOLDSMITH

Biology Department, State Teachers College, Salem, Massachusetts

Interest in club life, as in other things, is maintained at a higher level if there is active participation by all of the members, and if the activities are varied. Besides the usual field trips which invariably form a part of nature activities, the following are suggested as possibilities for any ordinary situation, some brief and pointedly seasonal, some of longer duration.

Manual dexterity is worth acquiring by all and if there are no regular manual training classes the making of bird feeders, nesting boxes, robin shelters, phoebe shelves, or bird baths will give opportunity for fairly simple problems. If there are regular classes, the "how" and "why" developed in club time may motivate some of the regular manual training periods. String bags, either crocheted or knotted, will serve for hanging out suet in the winter and again for nesting material in the spring. Observation and record keeping follow easily from any of these activities. In the spring also put out string, straw, hair and narrow strips of cloth hung loosely on a line or branches of trees and watch the birds who will eagerly take them for their nests. Experiment with different colors and see what interesting problems arise. A pan of mud, or a bare spot of earth where water drips constantly, will often entice robins to build near by. Insect cages with a removable pan give opportunity for much closer observation than can usually be obtained out-of-doors. They may be large or small, the latter

more for use with a very small group or an individual.

Flower arrangements, which offer another opportunity for exercise of creative ability, may be made for the home room, the assembly hall, for a sick companion, or some special occasion. A competitive show of flower arrangements may be found stimulating. In the autumn trips for the collection of seed foods, cones, and any long lasting fruit may be the introduction to the arranging of winter bouquets and the making of Christmas wreaths. Tiny boutonnieres for the Christmas season are always popular and may even be a source of income along with wreaths and swags.

An old idea, but new to the participants perhaps, is a table with an ever changing display of interesting or seasonal material maintained by club members. Be sure to change the material frequently and have it artistically arranged. A few things, even one, well cared for and well set up is much better than many things displayed with no thought of their arrangement.

Collections are always enticing at certain age levels and may be made to develop into a worthwhile hobby, but usually some guidance is needed. Leaves, seeds, grasses, seed foods, twigs in bud or in leaf for the study, and bird nests (if done at the proper time) are good subjects. A school museum may be the final result, either announced as the goal in the beginning or guided into that as the collection grows.

Games lend zest to any program but let the pupils make their own as much as possible. A game tournament can be carried on successfully allowing points to accrue for a semester, or even a year, and awarding a worthwhile prize to the winner at the end of the period. Have the games sufficiently varied so as to avoid any monotony and to appeal to different tastes and abilities.

Growing things have an appeal all their own aside from any final product and various types of plant propagation can be tried (cuttings, seeds, bulbs, root divisions and off-sets), followed by an exhibition of the results or a plant sale at Easter. Small vegetables and herbs should not be forgotten in the enthusiasm for the flowering plants. Aquaria and aviraria are always interesting and one may even start from the beginning and build the aquarium itself. Something a bit more ambitious, but perhaps even more interesting, is the arrangement of habitat groups which may include both plants and animals.

A well set up exhibit involves many desirable activities and is also satisfying in itself. Judge them not only for the amount of material shown but also the educational value and artistic arrangement. The kinds of exhibits are countless but one may suggest seed dispersal, bird protection, wild flowers (*not* rare ones), garden flowers, berry-bearing shrubs, fruits and their native country or where they are cultivated, nuts, wool, cotton or grains and their uses.

A survey of a limited area may be made to find out just what grows there or what has been planted. For example, map a section of the town or city and see what kinds of trees are planted there and locate them. Or take a section of a woodland, or a field, pasture or swamp and list all the wild flowers found there. Keep the list and visit the same place at intervals to find additional species and compare with other records. These are good problems to teach that field trips may be for observation only—a point which needs considerable emphasis if we are to teach conservation and foster a true appreciation of the out-of-doors.

ORRA ERVIN UNDERHILL, PH.D.

APRIL 21, 1898—JUNE 10, 1943

Orra Ervin Underhill, Ph.D., Associate Professor of Science at the Teachers College of Connecticut, died in New Britain, Connecticut, on June 10, 1943, after a valiant struggle of two years against an incurable disease. He displayed superb courage in the face of diminishing strength, teaching his classes to within a week of his death. He was born in Chelsea, Massachusetts, April 21, 1898, and received his early education in that city. He was graduated from the University of Maine in 1921 with the degree of B.S. and received both his M.A. (1927) and Ph.D. (1941) degrees from Teachers College of Columbia University.

Although still a young man at the time of his death, Dr. Underhill had spent many fruitful years in teaching science. His experience in secondary schools and in colleges was wide. For many years he spent summer sessions teaching at Hampton Institute, Virginia (1927–1931); the University of Alabama (1932); Lincoln School, Columbia University (1934); New Haven State Teachers College; State Teachers College, Buffalo, New York (1939–1940); and Teachers College of Connecticut, New Britain (1935–1938 and 1942). Full time work in teacher-training institutions was done at State Teachers College, Salem, Mass. (1925–1926), State Teachers College, Jersey City, and Teachers College of Connecticut, where he had been for the past nine years.

Educational progress was of vital importance to Dr. Underhill, and he spent much time in developing new techniques and experiments in the teaching of science, sharing them by making frequent contributions to *General Science Quarterly, Science Education,* and *School Science and Mathematics.* His article, "An Assembly Program: Edison," appeared in the May, 1928, number of *General Science Quarterly,* and frequent requests for copies during the succeeding fourteen years attest to its popularity.

His doctoral dissertation, *The Origin and Development of Elementary Science,* a noteworthy addition to research, was published by Scott, Foresman Company in 1941. He was co-author with Dr. S. Ralph Powers of the *Cooperative General Science Test,* Forms 1935, 1936, and 1937, and author of the Science Section of the first edition of the *Study Guide of the Britannica Junior.* He was Managing Editor of *General Science Quarterly* (1925–1926).

Various science organizations have lost a strong supporter in the death of Dr. Underhill. He was a familiar figure at meetings of the National Association for Research in Science Teaching, the American Association for the Advancement of Science, the American Science Teachers Association, the National Council on Elementary Science, taking an active part in discussion. His broad interest is further shown by his membership in the science section of the National Education Association, the American Museum of Natural History, the American Polar Society, the Research Associates in Science, the New England Association of Chemistry Teachers, and kindred organizations. He was a member of two honorary educational fraternities, Phi Delta Kappa and Kappa Delta Pi.

A liberal in his social and economic views, Dr. Underhill applied the scientific method to a marked degree in the problems of daily living. Although science was his chief interest, he found time for music, the theater, and participation in civic affairs. The untimely death of such an able man evokes more than passing regret. We shall miss him greatly.

W. G. WHITMAN.

RALPH E. HORTON

Sadly, we announce the sudden death on December 30, 1943, of Dr. Ralph E. Horton, beloved colleague and a national leader in the field of science teaching for many years.

Ralph E. Horton was born on February 18, 1885, in Hammondsport, New York. He was the son of a country doctor. He received his first degree from Alfred University in 1905 and shortly thereafter embarked on a career of science teaching at Easton, Ticonderoga and Amsterdam—all in New York State.

He entered the New York City school system as a teacher of Chemistry in the High School of Commerce in February, 1915. In 1924, he was appointed Chairman of the Department of Science at the Seward Park High School. He taught and supervised the teaching of all the secondary school sciences. He was also interested in many extra curricular activities. He was an accomplished athlete and a baseball coach for many years. He became so interested in aviation that last year he acquired a pilot's license.

In 1924, Ralph E. Horton received an A.M. degree and in 1928, a Ph.D. degree from Columbia University. His doctor's dissertation was entitled: *Measurable Outcomes of Individual Laboratory Work in Chemistry* (Teachers College Contributions to Education, No. 303, 1928). He was the author of secondary school textbooks in biology and chemistry and of many articles in science teaching in a number of magazines. He was a member of the American Chemical Society, a Fellow of the American Association for the Advancement of Science and a member and officer of many national and local science teacher associations.

In 1940, Dr. Horton was assigned to the New York City Board of Education headquarters as the Chairman of the Standing Committee on Science and became the guiding spirit of secondary science education in the New York City schools. In 1941, he took on the additional job of Director of War Courses for the high schools of New York City. He organized the preinduction courses and a specialized aviation program.

Science and science education are immeasurably richer because of Ralph E. Horton. We shall miss him sorely and treasure the memory of a fine gentleman, a pioneer scholar, and an inspirer of students and teachers.

MAURICE U. AMES
President, Federation of Science Teacher Associations of New York City

Abstracts

EDUCATION AND WAR

ANONYMOUS. "To Shun New Wars." *Science News Letter* 42: 391; December 19, 1942.

A possible planetary conflict in 1964, with immense battles raging over the Arctic and control of the whole world was envisioned in recent address by Prof. Harold C. Urey, 1943 Nobel Prize winner. Professor Urey based his remarks on the present distrust of our Russian ally by many Britons and Americans. Three possible courses appear to be open. Germany could be set up as a strong buffer state, but it is not probable that such a buffer could serve to absorb the shock of such a collision. A second alternative would be for Britain and the United States to attack and smash Russia immediately after the Axis is defeated, establishing a world-wide Pax Americana. The third possibility and the most workable one would be peaceful collaboration with Russia in policing the world. Russia at present has no more desire than we to conquer the world. For this collaboration to be effective, we must revise our approach to Russia. It must be neither from the standpoint of our own communists nor our "red-baiter," but rather from the standpoint of respect for a hard-working and hard-fighting ally. —C.M.P.

EDUCATION AND SCIENCE

PRESTON, C. E. "Teaching High-School Science in War-Time." *The High School Journal* 25: 298–302; November, December, 1942.

The author of this article, as usual, has his feet on the ground, which may be a good place for them in spite of this being an air age. He raises some very pertinent questions which should be considered carefully perhaps as much by the high school administrator as by the science teacher. The article is a plea for the broad and long range view rather than a more narrow concept of war-time education. This reviewer always has a hard time handling Dr. Preston's writings because of the temptation to quote them extensively. Early in the article occurs this statement: "To preach upon the values of science and then to teach science in the traditional somewhat abstract way, apart from outside happenings, certainly cannot be expected to make him more animated or interested than he has been up to now." He then urges the linking of principles with concrete examples made of immediate interest because of the war. Next he discusses the problem of meeting the need for specialized technical training as against the need for general interpretive knowledge by the rank and file, using aviation as illustration. The typical, small non-technical high school may react in two ways. "One is to center its regular physics course around aviation or to establish a separate aviation course. . . . Such a course might cater to popular superficial interest, but, given under ordinary classroom conditions, it would seem comparable to teaching a person to drive a car without ever putting him in the driver's seat." After a brief outline of possible broad points of contact he says ". . . the task of teachers would seem largely to be that of trying to do more effectively those things which they have already been doing. . . . It seems far more probable that they can do a better job through laying the broader background, leaving the specialized details to be taught within the actual service organizations. . . ." After elaborating somewhat on the relation of such a program to the peace to follow, as well as to the war, he summarizes: ". . . There seems to exist today a very possible danger that in their desire for immediate returns schools may throw their science curriculum too far off balance to give the nation the best and most lasting service."

—O. E. Underhill.

GLASS, RONALD D. "Return Engagement With Nature." *National Education Association Journal* 31: 120–121; April, 1942.

A good example of how, under proper leadership, a group of school children can make a real contribution to conservation programs. A pond near the school formerly used by migrating waterfowl had been abandoned for this purpose because of encroaching industrialization of the area. This article describes how the students of the school restored and restocked the pond as a wildlife sanctuary. This project furnished valuable learning experience in the science work besides having other useful concomitants.

—O. E. Underhill.

WEBB, ROBERT W. "Geology in Secondary Schools." *The Phi Delta Kappan* 24: 288–290; March, 1942.

Geology has advanced to an importance in modern life equivalent to chemistry and physics. Yet most college freshmen are unable to give a rational explanation of simple and fundamental geological processes, some of which are capable of being understood even by sixth graders. Material for first hand study is easily available and recreational opportunity enlarged by one's knowledge in this field. Because applied geology offers opportunities to those who specialize in it, and because it ties up in so many ways with modern chemical and mechanical engineering, students of

high school age should be given opportunity for some exploratory experience in this field. "Much of the neglect of geology and mineralogy in the secondary school curriculum is due to the teachers' lack of knowledge in this field of study." The background training of geology specialists fits them much more adequately to teach high school chemistry and physics, than the specialized training in chemistry and physics fits individuals to teach high school geology.

—O. E. Underhill.

JOHNSON, WALTER. "Film and Slide Booking." *Educational Screen* 22: 89–90; March, 1943.

A discussion of the "block" vs. "spot" booking. Nine reasons are cited as to why school systems still cling to block booking in spite of the disadvantages of this method in terms of what a sound program of visual education should be. This is followed by nine statements which give reasons for and methods of handling materials by spot bookings.

—O. E. Underhill.

LEDER, JON B. "School-Made Kodachrome Slide Units." *Educational Screen* 22:126–127, 146; April, 1943.

A simple method of arranging camera, supports, lights, etc., is described by means of which photographs, paintings, maps, drawings, etc., may be made into 2 x 2 color slides.

—O. E. Underhill.

GRAY, GEORGE W. "Decimal Points Shape Victory." *Science Digest* 14: 24–28; September, 1943.

This article is condensed from *The Technology Review* published by the Massachusetts Institute of Technology. The article emphasizes the importance of mathematics in the designing of war machines and in the training of the men who are to operate these machines. Courses at West Point and Annapolis are founded on a thorough and broad training in mathematics.

—C.M.P.

MATSON, VIRGINIA F. "Amateur Construction of Sound-slide Films." *The Educational Screen* 21: 346–347, 353; November, 1942.

The author describes how a combined 35 mm. film strip and accompanying recording was made. The subject matter of the film strip was the way in which biology in the Wells High School, Chicago, is made a dynamic part of the student's life. To a collection of 40 pictures already on hand depicting the biology laboratory work 15 others were taken and added to give continuity to the script. These were then imprinted upon kodachrome film to avoid splicing. The script recording was made on six ten-inch 78 rpm. records. A musical introduction was dubbed in from radio. Only a voice-pause was used to signal for the next slide, as the author believes the customary tone-beat is annoying to audiences. The author points out briefly that the method has great possibilities in many subject-matter fields. Her choice of this particular topic for her first experiment in this technique was dictated rather by convenience due to already having on hand most of the pictures necessary for its development.

—O. E. Underhill.

BLIVEN, BRUCE. "Scientists at Sixteen." *School and Society* 57: 57–61; January 16, 1943.

In this article the editor of *The New Republic* emphasizes the important work that many amateur high school science students are doing. Many of their projects and activities are carried out in the numerous science clubs, so often now affiliated with the *Science Clubs of America*, a national organization. Several science club activities and values are enumerated.

—C.M.P.

LANGMUIR, IRVING. "Science, Common Sense and Decency." *Science* 97: 1–7; January 1, 1943.

This is the address of the retiring president of the American Association for the Advancement of Science. Dr. Langmuir states that up to the beginning of the present century one of the main goals of science was to discover natural laws—perform controlled experiments, formulate hypotheses, retest. The usefulness of a theory lies in its ability to predict the results of future experiments. Up to 1900 the teachings of classical physics seemed to reenforce the idea of cause and effect. Then came the quantum theory and the principle of uncertainty. Now two types of phenomena are recognized: convergent and divergent. There has been an over-emphasis on the idea that general causes (convergent phenomena) dominate in human affairs over the results of individual action (divergent phenomena). Mass reactions may be predictable; individual reactions are usually not. The importance of intuition in science has been under-estimated.

—C.M.P.

TRANSEAU, EDGAR N. "The Golden Age of Botany." *Science* 95: 53–58; January 16, 1942.

This is the address of the retiring president of the Botanical Society of America. This golden age spans the forty year period between the Spanish-American War and World War II. It has been a golden age in every respect in increased attention to botanical problems and research, increased number of botanical workers, increased accomplishments, and the placing of botanical sciences on a desirable level. In 1906 the Botanical Society of America had 116 members; now the membership is 1,360, and in addition allied botanical societies list 1,125 plant pathologists, 625 plant physiologists, 500 plant taxonomists, 400 mycologists, and 275 bryologists. The 1906 edition of "American Men of Science" listed 169 botanists; the 1938 edition lists 1,677. Then there were about 11 doctorates in botany conferred each year; now the average is around 110.

—C.M.P.

BLAKESLEE, ALBERT FRANCIS. "Individuality and Science." *Science* 95: 1–10; January 2, 1942.

This is the address of the retiring president of the American Association for Advancement of Science, Dallas, Texas, December 29, 1941. Dr. Blakeslee stated that likes and dislikes are important determiners of our behavior. In his address many examples of the influence of heredity and environment were given. Some of these examples had to do with the senses of taste and small; another was concerned with selection of a title for this paper; another with the effect of the place of a name on a ballot and the number of votes received. One of the most marked aspects of science is its individuality.

—C.M.P.

ANONYMOUS. "Langley Dispute Ends." *Science News Letter* 42: 292; November 7, 1942.

This article relates some of the history of the long drawnout dispute between Langley and the Wright brothers as to the original discoverer of the airplane. At long last, Dr. Charles G. Abbot, secretary of the Smithsonian Institution, credits the Wrights with the discovery. Possibly the original Kitty Hawk plane will be returned from England to the United States. —C.M.P.

COOLIDGE, WILLIAM D. "Seventy Years of Physical Science." *Popular Science Monthly* 140: 52–57, 198–202; May, 1942.

This article summarizes the important science accomplishments of the last seventy years, which is the time "Popular Science Monthly" has been in existence. Science has given us electric lights, airplane, radium, X-rays, radio, telephones, automobiles, atomic research, and much more.

—C.M.P.

HOLMES, HARRY N. "National Survival Through Science." *Science* 96: 433–439; November 14, 1942.

This is the presidential address given at the Buffalo meeting of the American Chemical Society. Showing, through numerous citations, that the basis of modern civilization is science, the author emphasizes that our very existence as a nation now depends upon the ability of science to maintain past achievements and possibly upon the great improvement of the present upon scientific processes, but also upon discovery of wholly new methods. —C.M.P.

COOLIDGE, WILLIAM D. "The Role of Science Institutions in Our Civilization." *Science* 96: 411–417; November 6, 1942.

"The science laboratory of today is the temple in which we come directly in contact with nature herself. The dedication of a new laboratory or the creation of a new scientific society has (in countless instances) constituted the beginning of a great tradition." Dr. Coolidge cites many contributions that science has made to civilization both in institutional endeavor and also in industrial laboratories. —C.M.P.

STINE, CHARLES M. A. "Molders of a Better Destiny." *Science* 96: 305–311; October 2, 1942.

Science is the molder of a better destiny, a forerunner of better days to come. Under the pressures of the moment, science is making great progress—progress in months as compared with that of years or even a century, during ordinary peacetimes. Examples of scientific advances are given from various aspects of science.

—C.M.P.

SECONDARY SCIENCE

SIMMONS, MAITLAND P. "Do Your Science Projects Reach Home?" *School Activities* 14: 89–90; November, 1942.

The values of science project work by high school pupils is vigorously defended in this article. Specific values resulting from the making of a bathysphere are given. —C.M.P.

MUROFF, JOHN M. "Activities for a Science Club." *School Activities* 13: 254–258; March, 1942.

This article on science clubs discusses the desirability, the membership, the dues, the qualifications of the sponsor, and the activities of science clubs. A fairly complete bibliography is included. —C.M.P.

RAGAN, IRMA. "Suggestions for a Photography Club." *School Activities* 14: 58–61; October, 1942.

Practical suggestions in detail are given for month by month activities of both junior and senior photography clubs. —C.M.P.

ANONYMOUS. "Supermagnets." *Popular Science Monthly* 141: 41–45; July, 1942.

Supermagnets, alloy in composition, are being used extensively, resulting in the saving of much energy. Many such magnets are able to lift from 50 to 60 times their own weight, and in special mountings up to 4,500 times their own weight.

The alloys are made into permanent magnets by holding the alloy a fraction of second between the poles of a magnetizer coil when the current is turned on. —C.M.P.

KRAUS, JOSEPH H. "Terms Related to the Study of Matter." MOTT-SMITH, MORTON. "Magnetism Explained, Many Uses." DAVIS, WATSON. "War—It's Technical." *Science News Letter* 42: 328–329; November 21, 1942.

The first two articles are two brief science units produced under the auspices of *Science Service* to present the fundamentals of technical training recommended for pre-induction training by the War Department. These units will appear weekly in newspapers all over the country.

—C.M.P.

ANONYMOUS. "Home Experiments." *Popular Science* 142: HW44–HW45; March, 1943.

The following experiments are described and illustrated: short circuits, radio static, why batteries "pick up," magnetic lines of force about a conductor, and electricity obtained from cells in series and cells in parallel.

—C.M.P.

SWEZY, KENNETH M. "Textile Chemistry." *Popular Science Monthly* 141: HW254–HW256; September, 1942.

This article explains tests identifying common textile materials: wool, silk, cotton, viscose rayon, and acetate rayon.

—C.M.P.

ANONYMOUS. "Chlorine." *Popular Science Monthly* 141: HW440–HW442; December, 1942.

This illustrated article describes several experiments showing how industry uses versatile chlorine. —C.M.P.

ARMAGNEC, ALDEN P. "Phosphorus." *Popular Science Monthly* 141: 108–112; October, 1942.

Phosphorus is an important strategic element in which the United States is well supplied. It is the chief smoke-screen producer, used extensively as an incendiary agent in bombs, shells, and scatter-type missiles. The article also describes the process of recovery, chiefly by the electric furnace method.

—C.M.P.

SWEZEY, KENNETH M. "The Unfriendly Element." *Popular Science Monthly* 142: HW568–HW570; February, 1943.

A number of interesting experiments illustrating the properties of nitrogen are described.

—C.M.P.

BOONE, ANDREW R. "Home Spotter's Guide." *Popular Science* 142: 116–119; March, 1943.

Complete directions are given for removing spots caused by blood, bluing, candy, coffee, fruits and berries, grease, milk and cream, ink and perspiration.

—C.M.P.

ANONYMOUS. "Mystifying Tricks for the Dinner Table." *Popular Science Monthly* 141: HW252–HW253; September, 1942.

Six tricks are described and illustrated as follows: seeing through your hand, when a glass isn't full, magic toothpicks, the rising egg, short timbers support roof, and gas smothers match flame.

—C.M.P.

ANONYMOUS. "Home Experiments." *Popular Science Monthly* 141: HW443; 142: HW507; December, 1942, January, 1943.

Seven home experiments are illustrated and described. These are as follows: water as an insulator, stump your friends, model thermocouple, squeeze the bottle, electrified bubble expands, liquid conductors, and simple test for water.

—C.M.P.

SCIENCE

ANONYMOUS. "Indian Summer Days." *Science News Letter* 42: 285; October 31, 1942.

Any warm, quiet spell, following cool or chill fall weather, may be called Indian Summer. It has no fixed date, no definite duration. The meteorological background is a "stalled" high-pressure area somewhere in the Southeast, with a large area of low pressure backed up in or near the Yukon valley.

—C.M.P.

ANONYMOUS. "Distant Planet." *Science News Letter* 42: 339; November 28, 1942.

The irregular orbits of an obscure double star in Cygnus, the Swan or Northern Cross indicate the presence of a third small object, far smaller than the mass of any known star (about one-sixtieth that of the sun or 16 times that of Jupiter). It has an orbital period of about 4.9 years with a decidedly lop-sided orbit. It may be the first extra-solar-system planet possibility.

—C.M.P.

ANONYMOUS. "More Worlds in Heavens, Perhaps, Than Supposed." *Science News Letter* 42: 99; August 15, 1942.

Sir James Jeans, propounder of the tidal theory of planet origin, has recently stated the belief that solar systems may be very much more numerous than once believed. He believes that the universe may even be relatively crowded. This new assumption is based upon the belief that the sun at the time of planet formation was possibly much greater in size than it is at present. Such a size (diameter of the present solar system) would increase chances of near star encounters to 1 in 8 from 1 in 2,500,000,000.

—C.M.P.

BEEBE, WILLIAM. "How Lost Jungle Fighters Can Survive." *Popular Science* 142: 49–53; March, 1943.

Soldiers lost in the jungle may have to depend upon the sun to give guidance in direction. Animal food in the tropics will not be so difficult, as grubs, frogs, snakes, lizards, monkeys and many other creatures may be had. Vegetable food is more of a problem as so much is poisonous. However one may safely eat fruit if he first sees a gibbon or flock of parrots eating the fruit or nuts. Danger from poisonous snakes is not so great or is even practically nil (as have testified many other jungle travelers). There is danger from malaria and dysentery. Running water is safer to drink than stagnant water.

—C.M.P.

Book Reviews

Catalog of Technical Books

A new catalog of technical books has just been issued by The Chemical Publishing Co., Inc., 26 Court Street, Brooklyn 2, N. Y. This catalog includes the latest books on chemistry, technology, physics, general science, mathematics, engineering, radio, aviation, foods, formularies, cosmetics, gardening, medicine, metals, technical dictionaries, etc.

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A copy of this catalog will be sent free to everyone who is interested in keeping up with the latest technical and scientific progress.

—W. G. W.

HANSEN, MORRIS H. *Statistical Abstracts of the United States, 1942.* Washington: Government Printing Office, 1943. 1097 p. $1.75.

This is a useful volume for many business men, legislators, economists, students, and statisticians. It gives reliable statistics relating to a wide variety of topics in the social, economic, industrial, and commercial fields. Some of the thirty-five section headings are: area and population, defectives and delinquents, vital statistics, immigration and naturalization, education, climate, military and civil services, national finances, wages and employment, social security, power, transportation, irrigation, farms, forests, fisheries, mining, housing, national park system.

This volume is the 64th annual edition of this publication which includes summary statistics on many subjects from governmental and non-governmental sources.

—W. G. W.

CORNETET, WENDELL H., AND FOX, DANIEL W. *Principles of Electricity.* Bloomington, Ill.: McKnight and McKnight, 1943. 255 p. $1.60.

This is a combination textbook, workbook, laboratory manual for a pre-induction course in electricity. For this type of book, the authors have seemingly done an excellent job. There are numerous illustrations, questions, and problems. The laboratory approach has been emphasized. The authors are high school teachers at Huntington, West Virginia, and have had long experience as science teachers.

—C.M.P.

CARNEGIE-ILLINOIS STEEL CORPORATION. *Electricity.* New York: American Book Company, 1943. 194 p. $1.16.

This pre-induction textbook in *Electricity* is based upon the experience the authors have had in the training of apprentices and learners. Thus, this treatise has the advantages of utilizing the practical experiences of men in a large industry as to what they think are the most fundamental needs of beginners in the study of electricity. Numerous illustrations and questions supplement the textual material. Students using this text should obtain a background of the fundamentals of elementary electricity and some comprehension of important industrial applications.

—C.M.P.

CUSHING, BURTON L. *Fundamentals of Machines.* WILLIARD, LESTER R. *Fundamentals of Electricity.* Boston: Ginn and Company, 1942. 436 p.; 351 p. $1.24 each.

These two textbooks have been prepared to meet the needs of pre-induction training courses in Fundamentals of Machines and Fundamentals of Electricity by the United States War Department. Such courses lead to operational skills that are basic to twenty-four army occupations in machines and to many more in electricity. The textual material includes many demonstrations and twenty laboratory experiments to be done by the pupil. Military applications of principles have been emphasized throughout the books. This is also true of the diagrams and the photographs. The courses are each intended for one semester of about 90 periods, of which 70 periods are for directed demonstration and discussion, 15 periods for laboratory exercises and 5 periods for review and tests.

—C.M.P.

SLACK, EDGAR P. *Elementary Electricity.* New York: McGraw-Hill Book Company, Inc., 1943. 305 p. $2.00.

This present revised edition meets the requirements of the pre-induction course in the fundamentals of electricity recommended by the War Department and the United States Office of Education. Practical applications are emphasized and are based on the author's thirty years of varied teaching work.

Elementary Electricity would seem to serve most adequately either as a textbook or as an excellent supplementary source book.

—C.M.P.

FROST, JAMES V. *Pre-Service Course in Automotive Mechanics.* New York: John Wiley and Sons, Inc., 1943. 545 p. $1.96.

This text was prepared at the request of the War Department and the United States Office of Education. There are nine chapters, the first five intended for the first semester, and the last four for the second semester. Numerous illustrations supplement the well-written textual material. Science teachers will find this an excellent, most understandable treatise on the automobile.

—C.M.P.

POPE, FRANCIS, AND OTIS, ARTHUR S. *Elements of Aeronautics.* Yonkers, N. Y.: World Book Company, 1941. 653 p. $2.92.

Elements of Aeronautics, a pioneer in its field, merits the extensive use it has had since its first publication. It is an easy and practical approach to the science and art of aviation. It will serve as a point of departure for a study of more technical books. One of the authors was a transport pilot for many years and is now in the Army Air Corps. The other author is an experienced educator.

The book is comprehensive, well written with not too many technical terms, nor an overabundance of mathematics. Test questions for each part of the book may be obtained. There is also a teacher's manual.

There are five major divisions: (1) "Learning to Fly," (2) "Aerodynamics," (3) "Avigation," (4) "Meteorology," and (5) "Aids and Safeguards."

—C.M.P.

ROBINSON, PEARLE THURBER, MIDDLETON, FREDERIC A., RAWLINS, GEORGE M., JR., AND PHILLIPS, JOSEPH W. *Before You Fly.* New York: Henry Holt and Company, 1943. 56 p. $2.00.

Before You Fly presents the essentials of aeronautics and is intended as a high school text. The material is based upon a course of study used in eight of the senior high schools in Washington. Three of the authors have had practical experience in flying and Dr. Rawlins is Head of the Department of Science for the Washington schools. Mrs. Robinson and Mr. Middleton have taught aeronautics in the Washington schools. Dr. Phillips is now a major in the United States Army Air Corps.

There are 373 illustrations, a complete glossary, pupil's bibliography, and teacher's manual. The book is most attractive and readable and would serve excellently as the basic text for any course in high school aeronautics and as an excellent introduction for other teachers and laymen who desire a better understanding of aeronautics.

—C.M.P.

SIEMENS, CORNELIUS H. *Aeronautics Workbook.* Boston: Ginn and Company, 1942. 174 p. $1.00.

This workbook covers, unit by unit, the program outlined in Leaflet No. 63, United States Office of Education. Each of the seventy-five problems is an independent problem. The workbook intends to help students to gain competence in skills and abilities necessary in solving basic problems in aerodynamics, meteorology and avigation. All data and symbols used are up to date. Undoubtedly the use and mastery of the materials of this workbook would provide any student with an excellent groundwork in preflight aeronautics.

—C.M.P.

EBY, GEORGE S., WAUGH, CHARLES L., WELCH, HERBERT E., AND BUCKINGHAM, MAJOR BURDETTE H. *The Physical Sciences.* Boston: Ginn and Company, 1943. 493 p. $2.28.

This is a textbook in physical science intended for the high school. Four units of materials have been selected from the four major physical science fields. The four units, in order of their presentation, are as follows: (1) "Sun and Stars," (2) "Earth Sciences," (3) "Physics That All Should Know," and (4) "Chemistry That All Should Know."

Of the less than half dozen textbooks in physical science intended for high school use that have been published, this one seems to the reviewer to be easily superior. The type of material selected, the illustrations, and study aids are all of high order. Altogether the authors have done an excellent job, one thing that perplexes the reviewer, and yet does not detract from the worthwhileness of the text itself, is how did the authors discover exactly what chemistry and physics that "all should know." Had the book no other merits, this alone would make it an outstanding contribution! And to think, they do not let their readers into the little secret of how they found out.

—C.M.P.

MENDENHALL, JAMES E., AND HARAP, HENRY. *Consumer Education.* New York: D. Appleton-Century Company, 1943. 399 p. $2.50.

This book presents the background, present status, and future possibilities of consumer education. Consumer education represents an extremely important, relatively new and undeveloped field with rapidly increasing significance. Both within and without the school, consumer education has caught the public fancy. This treatise is probably the best that has yet been published in this field. There are twenty chapters by twenty-three leaders in the field of consumer education. One chapter by Dr. H. Emmett Brown of Teachers College is entitled "What Teachers of Science Can Do."

—C.M.P.

HENNEY, KEITH. *Principles of Radio.* New York: John Wiley and Sons, Inc., 1942. 549 p. $3.50.

This is the fourth edition of a book first printed in 1929. The viewpoint that has persisted throughout the four printings is that the material is intended for those students who have little background in radio upon which to build, and yet who wanted to know the basis upon which radio communication exists. Today radio is more important than it has ever been in its entire history. More men are now taking radio training than ever before. And this trend will continue so long as the war shall last.

Principles of Radio seems to be most practical and readable. The revision is most timely, bringing up to date, as it does, the latest development in this field.

—C.M.P.

Science Education

The Official Organ of the National Association for Research in Science Teaching, the National Council on Elementary Science, and the Science Association of the Middle States

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NOTICE TO SUBSCRIBERS

We regret that circumstances of an unfortunate nature have caused irregularity of issue of SCIENCE EDUCATION recently. To correct this situation, the Board of Directors of SCIENCE EDUCATION, INC., has empowered a committee to take such action as seems necessary to restore the Journal to usefulness. You may expect full-sized numbers and regular publication beginning with Vol. 28.

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